Rabies Surveillance in California

Annual Report 2020

Veterinary Public Health Section
Infectious Diseases Branch
Division of Communicable Disease Control
Center for Infectious Diseases
California Department of Public Health

January 2022

Introduction

Rabies is a severe zoonotic encephalitis caused by a Rhabdovirus of the genus *Lyssavirus*. Following an incubation period that can range from a few days to several years, early clinical signs and symptoms of rabies--including headache, fever, chills, cough or sore throat, anorexia, nausea, vomiting, and malaise--are non-specific and can be mistaken for more common conditions. Symptoms progress rapidly (within 1-2 weeks) to central and peripheral neurologic manifestations including irritation at the site where the virus was introduced, altered mental status (e.g., hyperactivity and agitation), hydrophobia, excessive salivation, and difficulty swallowing due to laryngeal spasms. Ultimately, autonomic instability, coma, and death occur, due mainly to cardiac or respiratory failure. No treatment protocol has proven consistently effective for clinical rabies and reports of patients surviving are exceedingly rare. If a person is exposed to the virus, prompt post-exposure prophylaxis (PEP) by administration of rabies immune globulin and vaccine can prevent progression to clinical rabies.

Rabies virus variants (RVV) are maintained in certain mammalian species, but all rabies viruses are capable of infecting any mammal, including humans. In California, bat RVVs exist throughout the state, while the California skunk RVV is found mostly north of the Tehachapi mountain range. Domestic animals (dogs, cats, and livestock) can be infected with these RVVs through contact with rabid wildlife; but the rarity of domestic animal rabies in California limits the potential for the virus to evolve and sustain transmission in these species. Each year since 1957, the Director of the California Department of Public Health (CDPH) has identified counties in California where rabies constitutes a public health hazard. The Director has declared all 58 counties in California as rabies areas every year since 1987.

Since the early 20th century, CDPH has overseen a statewide rabies surveillance and control program. Local departments of public health and environmental health, animal control agencies and shelters, and medical and veterinary practitioners collaborate with CDPH to prevent rabies in California by:

- Providing reliable laboratory services for the diagnosis of rabies in humans and animals,
- Regulating and enforcing rabies vaccination of dogs to provide a protective “firewall” that reduces the potential for human exposure,
- Investigating reports of animals that bite humans,
- Evaluating animals for rabies by confinement and observation for a specified period, or by euthanasia and testing,
- Offering recommendations for PEP to persons following a known or suspected exposure to rabies,
- Developing and disseminating preventive education on rabies, and
- Collecting, collating, and reporting surveillance data on rabies in humans and animals.

Reporting and Analysis

The California Code of Regulations (17 CCR §2500) lists rabies that is diagnosed in either humans or animals as a reportable disease. Health care providers, including physicians and veterinarians, having knowledge of a confirmed or suspected case of rabies are required to report this knowledge immediately to the local health officer. Diagnostic testing of human patients with signs and symptoms suggestive of rabies is challenging, and no single test can accurately diagnose rabies ante-mortem. Therefore, several tests on multiple tissue samples are typically pursued. Diagnosis can be made by detection of virus antigen in nuchal skin biopsy, brain biopsy, or saliva by direct fluorescent antibody assay (DFA) or polymerase chain reaction; or by demonstration of rabies-specific antibodies in blood or cerebrospinal fluid of previously unvaccinated patients by immunofluorescent antibody assay or Rapid Fluorescent Focus Inhibition Test (RFFIT). Infection with rabies is confirmed post-mortem in humans and animals by detection of rabies virus antigen, typically in central nervous system tissue, by DFA performed by a certified public health microbiologist. In 2020, 30 local public health laboratories in California employed trained microbiologists and maintained resources to perform rabies testing in animals. The CDPH Viral and Rickettsial Diseases Laboratory (VRDL) provides primary and confirmatory testing for rabies in animals, diagnostic testing of human patients suspected to have rabies, and characterization of rabies viruses to variant type. Local public health departments report confirmed cases of rabies in humans and animals to CDPH. This surveillance report summarizes information on confirmed cases of rabies in humans and animals reported to CDPH in 2020.

Rabies in Animals

In 2020, specimens from 4,649 animals were tested for rabies in California – approximately 17 percent fewer than the annual average of 5,589 specimens tested during the previous ten years, 2010-2019. Of the 55 counties that submitted at least one animal for rabies testing, the number of animals tested per county ranged from 1 to 601.

Rabies was confirmed in 248 animals, less than the 276 cases confirmed in 2019 but 11 percent above the annual average of 224 cases in 2010-2019 (Table A). One or more rabid animals were identified in 41 counties, which reported between 1 and 51 rabid animals each.

Wild Animals

Rabies was diagnosed in 246 wild animals in 2020, accounting for 99 percent of all rabid animals reported to CDPH. Bats (221, 89.1%) were the wild animal most frequently reported rabid, followed by skunks (24, 9.7%), and a fox (1, 0.4%).

Bats

A total of 1,974 bats from 53 counties were tested for rabies in 2020 (Figure A). The 221 rabid bats reported in 2020 is 14.5 percent higher than the annual average of 193 reported in the preceding ten years, 2010-2019 (Figure B). The greatest number of rabid bats (51) was reported in Los Angeles County, which reported the most rabid

bats in each of the past ten years (Table A, Figure C). The six southern California counties of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura collectively accounted for 117 (53%) of all rabid bats detected in California in 2020. Rabid bats were most frequently reported during the summer and early autumn months; roughly two thirds (142, 64%) of all rabid bats were reported in the five months of June through October (Figure D).

Skunks

A total of 265 skunks (*Mephitis mephitis*) from 34 counties were tested for rabies in 2020, of which 24 from 11 counties were confirmed rabid (Figure A, B). The 24 rabid skunks in 2020 was comparable to the annual average of 24 in the preceding ten years, 2010-2019. The greatest numbers of rabid skunks were reported in El Dorado (7) and Sacramento (4) counties.

Foxes

A total of 29 foxes from 14 counties were tested for rabies in 2020. The single fox confirmed rabid in 2020 is less than the annual average of three foxes reported in the previous 10 years, 2010-2019 (Figure B).

Domestic Animals

In 2020, 2,099 domestic animals (dogs, cats, horses, cattle, goats, sheep, and swine) were tested for rabies. Rabies was confirmed in one cat and one dog (Figure E) which was comparable to the annual average of 2.4 rabid domestic animals reported in the previous 10 years, 2010-2019.

In June 2020, a young unowned kitten from Amador County was presented to a local veterinarian with twitching and inability to stand or walk. The kitten died later that day. Brain tissue tested positive for rabies virus at San Joaquin County Public Health Laboratory. No exposures meriting rabies PEP were identified among veterinary clinic staff.

In July 2020, a free-roaming female dog of unknown age from San Joaquin County was presented to a local veterinarian with history of approximately three days of neurologic signs, including twitching, increased aggressiveness, and hypersensitivity to sound. The dog died at the veterinary clinic the same evening. Brain tissue tested positive for rabies virus at the San Joaquin County Public Health Laboratory; these results were confirmed at CDPH-VRDL. No information on its route of exposure to rabies virus was available owing to the dog having been found as a stray approximately two weeks prior to onset. Rabies post-exposure prophylaxis (PEP) was recommended for a total of ten persons who had contact with the dog at the veterinary clinic or on the property where it was collected.

Rabies in Humans

Rabies was not diagnosed in any California resident in 2020. Two cases of rabies were diagnosed in California residents in the previous ten years (2010-2019), the most recent in a Contra Costa County resident in 2012.

Rabies in the United States

At the time of this report, United States rabies surveillance data for 2020 has not been published.

Discussion

Bats were the most frequently reported rabid animal in California in 2020, as they have been each year since 2000. Over the last 20 years, bats have accounted for 62 to 95 percent of all rabid animals identified in California. The 221 rabid bats observed in 2020 was the third highest number of rabid bats observed in California, surpassed only by 227 in 2012 and 230 in 2019. A similar pattern has been observed nationwide; the number of rabid bats reported each year has gradually increased, from roughly 700 cases per year in the early 1990s to over 1600 cases in 2018. In contrast, cases of rabies in terrestrial reservoirs—raccoons and skunks—have concurrently diminished. While ambitious control efforts—namely through deployment of millions of doses of oral rabies vaccine baits each year targeted toward raccoons—can partially account for the drop in regional terrestrial rabies, the expansive increase in reported bat rabies remains largely unexplained.

In the United States, bat RVVs are the predominant cause of human rabies. Of the 38 U.S. cases of human rabies between 2000 and 2020 that could be attributed to indigenous transmission (case-patient had no history of travel outside the U.S. during the incubation period), exposure to bats or bat RVVs was responsible for 31 (86%)—including California's most recent human rabies case in 2012 [Ma 2021]. Given the broad species (51 different bat species) and geographic range of rabies in bats, any bat can and should be considered a potential source of rabies virus. The most reliable strategy for preventing bat rabies transmission is to avoid direct contact with bats. Live bats that are found immobile inside a building should not be handled but secured (e.g., inverting a bucket over the bat) and local animal control contacted. Any direct contact with a bat should be evaluated and discussed with a health care provider. If a bite from a bat cannot be absolutely ruled out, the bat should be submitted to a public health laboratory for rabies testing. If the bat tests positive or is unavailable for testing, rabies PEP should be initiated as soon as possible.

Skunks continued to be the second most frequently reported rabid animal in California. A unique RVV circulates in California skunks in historically recognized enzootic regions. The principal concentration of skunk rabies in California is along the western Sierra Nevada foothills from Madera County northward to Placer County. These seven counties, plus Sacramento County, accounted for 19 (79%) of 24 rabid skunks in 2020, and over three quarters (196 of 245; 80%) of rabid skunks detected in the last ten years (2011-2020). Sporadic cases of skunk rabies are also regularly identified in the coastal counties of Monterey and Santa Barbara. Since the early 2000s, cases of rabies in California skunks have stabilized at 20-40 cases per year. This steady state represents a roughly 90% decrease in reported incidence from the 1980s and 1990s when up to 400 cases were reported per year. While the factors contributing to this rapid decline are unclear, the fewer rabid skunks in California reflects similar trends observed nationwide. Since the peak of roughly 4000 cases in the early 1980s, cases of rabies attributed to the North Central and South Central skunk RVVs have steadily

declined to only a few hundred in 2019 [Ma 2021].

Rabies was identified in two domestic animals—one dog, one kitten—both of which were unowned. The risk of rabies presented by a bite from an unowned dog or cat is difficult to quantify. Such animals are presumed to have received little to no veterinary care, including vaccination against rabies. Free-roaming animals—whether truly unowned or owned but unconfined ("stray")—also have greater opportunity for contact with wild animals, including potentially rabid bats and skunks. While unowned animals may more frequently encounter rabid wildlife, this enhanced exposure opportunity may not translate into an epidemiologically greater threat of secondary transmission to humans. Most reported dog bites derive from animals owned by or known to the bite victim [Gandhi 1999, Kaye 2009], likely largely due to the more frequent, more intimate, and less cautious interaction one has with familiar, familial pets. Bites from truly unowned animals are comparatively rare, but present unique challenges for patient care and followup. In one study, although bites from stray or unowned dogs represented only 20 percent of all bites reported, a greater proportion of persons bitten by free-roaming dogs sought medical care compared to those bitten by owned dogs [Beck and Jones 1985]. At least one study has demonstrated that owned but unconfined dogs may be more aggressive compared to truly unowned dogs [Rubin and Beck 1985], potentially resulting in more severe injuries requiring medical attention. For the dog bite victim, little evidence may be available to differentiate between an owned but unrestrained ("stray") dog and one that is truly unowned and free-roaming. Furthermore, local animal service officials confront the challenge to reliably identify, locate, and collect a reported biting animal based on the bite victim's recollection and testimony. Risk of rabies remains rare among domestic dogs and cats in California, including those that are unowned. But when a biting animal's owner cannot be contacted, the animal's vaccination history cannot be verified. In addition, information available to identify the free-roaming animal, and resources available to search for it, may be insufficient to locate and seize the animal in a timely fashion for post-bite quarantine or testing. In these circumstances where limited information on the animal's history and health is available, the conservative assumption is that the bite represents a potential rabies exposure and the bite victim is typically advised to initiate rabies PEP. If the animal is subsequently recovered and determined not to be rabid, the bite victim can decide with the victim's health care provider whether to discontinue or complete the PEP series.

References

Beck AM, Jones BA. Unreported dog bites in children. *Public Health Reports* 1985; 100:315-321.

Gandhi RR, Liebman MA, Stafford BL, Stafford PW. Dog bite injuries in children: a preliminary study. *American Surgeon* 1999; 65:863-864.

Kaye AE, Belz JM, Kirschner RE. Pediatric dog bite injuries: a 5-year review of the experience at The Children's Hospital of Philadelphia. *Plastic and Reconstructive Surgery* 2009; 124:551-558.

Ma X, Monroe BP, Wallace RM, et al. Rabies surveillance in the United States during 2019. *Journal of the American Veterinary Medical Association* 2021; 258:1205-1220.

Rubin H, Beck AM. Ecological behavior of freeranging urban pet dogs. *Applied Animal Ethology* 1982; 8:161-168.

Table A. Reported cases of rabies in animals, California, 2020.

COUNTY	BAT	SKUNK	CAT	DOG	COYOTE	FOX	HORSE	SHEEP	CATTLE	RACCOON	TOTAL
TOTAL	221	24	1	1	0	1	0	0	0	0	248
Alameda	3										3
-Berkeley City	1										1
Alpine											0
Amador	2	1	1								4
Butte	6										6
Calaveras	1	3									4
Colusa	1										1
Contra Costa	3										3
Del Norte											0
El Dorado	3	7				1					11
Fresno	4										4
Glenn	1										1
Humboldt											0
Imperial	1										1
Inyo											0
Kern	1										1
Kings											0
Lake											0
Lassen	1										1
Los Angeles	51										51
-Long Beach City											0
-Pasadena City											0
Madera		1									1
Marin	10										10
Mariposa											0
Mendocino											0
Merced	1										1
Modoc											0
Mono											0
Monterey		1									1
Napa											0
Nevada											0
Orange	19										19
Placer	4	1									5
Plumas											0
Riverside	16										16
Sacramento	3	4									7

Table A (continued). Reported cases of rabies in animals, California, 2020.

COUNTY	BAT	SKUNK	CAT	DOG	COYOTE	FOX	HORSE	SHEEP	CATTLE	RACCOON	TOTAL
San Benito											0
San Bernardino	22										22
San Diego	8										8
San Francisco	1										1
San Joaquin	2	2		1							5
San Luis Obispo	1										1
San Mateo	4										4
Santa Barbara	4	1									5
Santa Clara	6										6
Santa Cruz	1										1
Shasta	1										1
Sierra											0
Siskiyou	1										1
Solano	1										1
Sonoma	5										5
Stanislaus	1	1									2
Sutter	1										1
Tehama											0
Trinity	1										1
Tulare	4										4
Tuolumne		2									2
Ventura	1										1
Yolo	21										21
Yuba	3										3

Source: California Department of Public Health, Veterinary Public Health Section

Figure A. Selected wild and domestic animals tested for rabies in California, 2011- 2020.

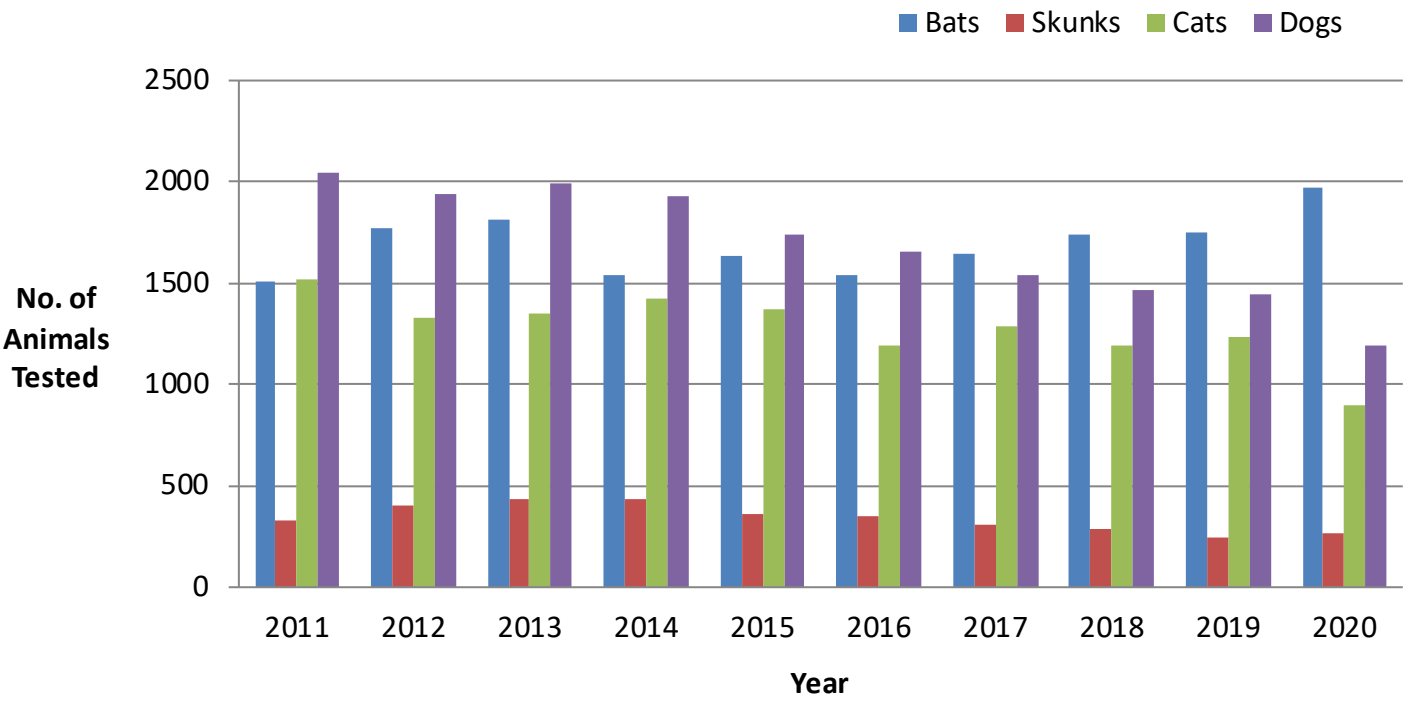

Figure B. Cases of rabies in wild animals in California, 2010-2020. (Ten-year averages represent 2010-2019 data.)

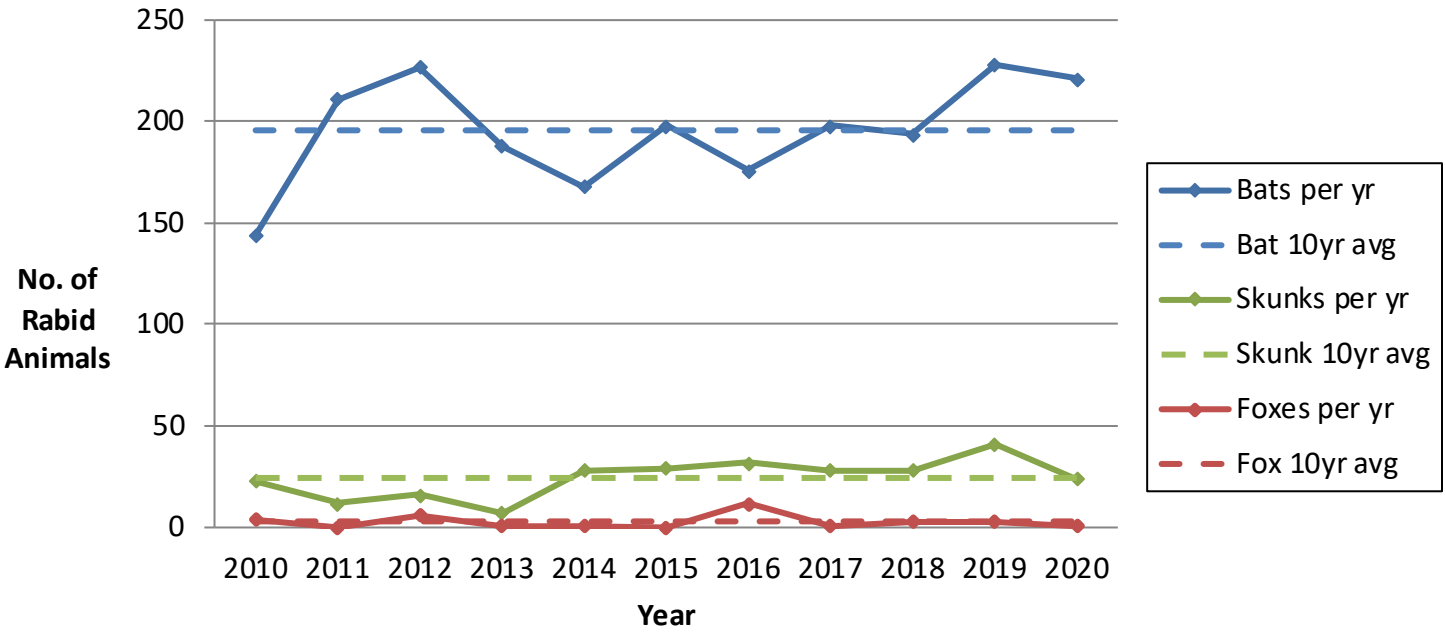

Figure C. Bats tested for rabies by county with positive cases by zip code of collection site, California, 2020.

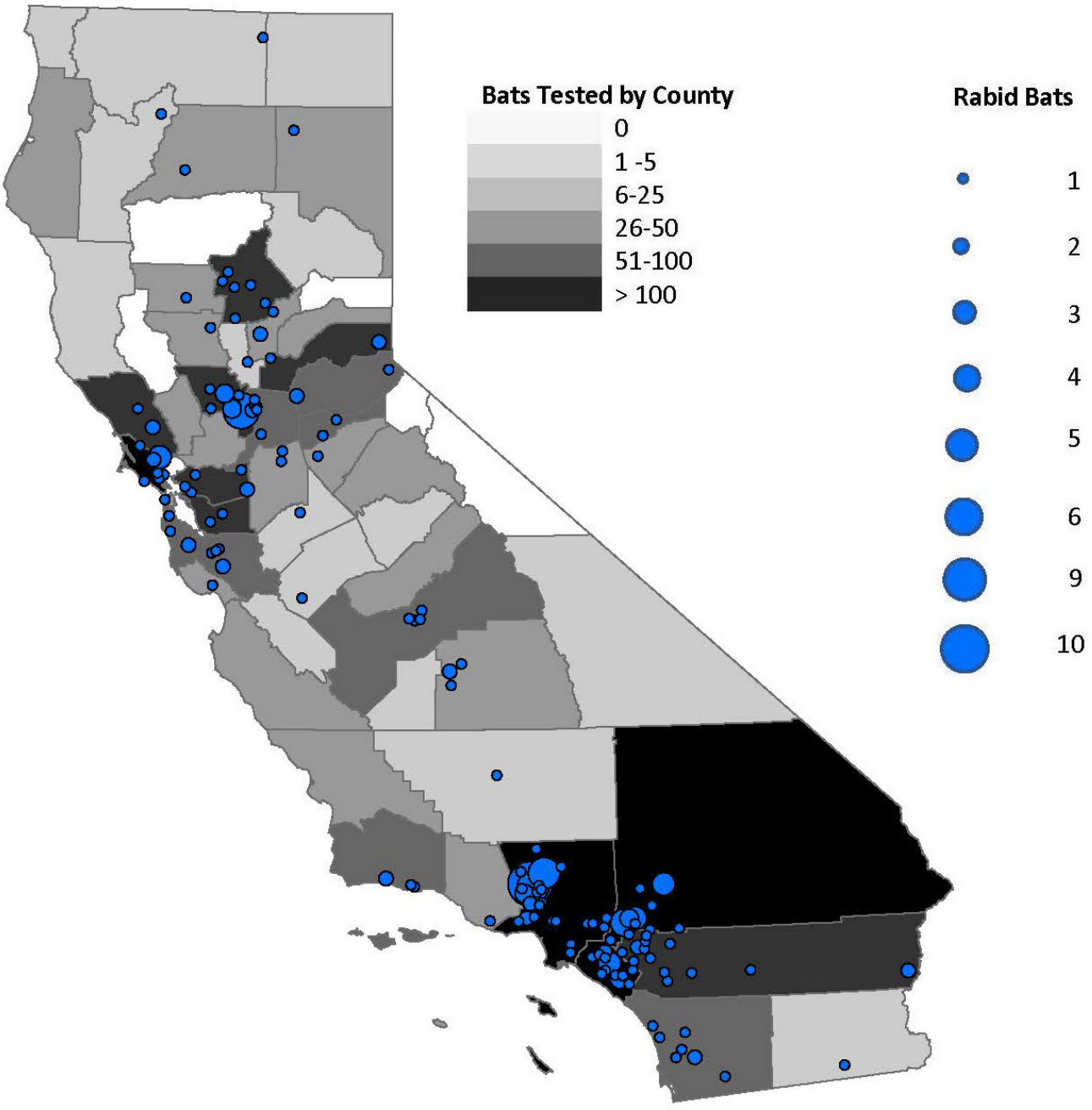

Figure D. Cases of rabies in bats by month of testing, California, 2020.

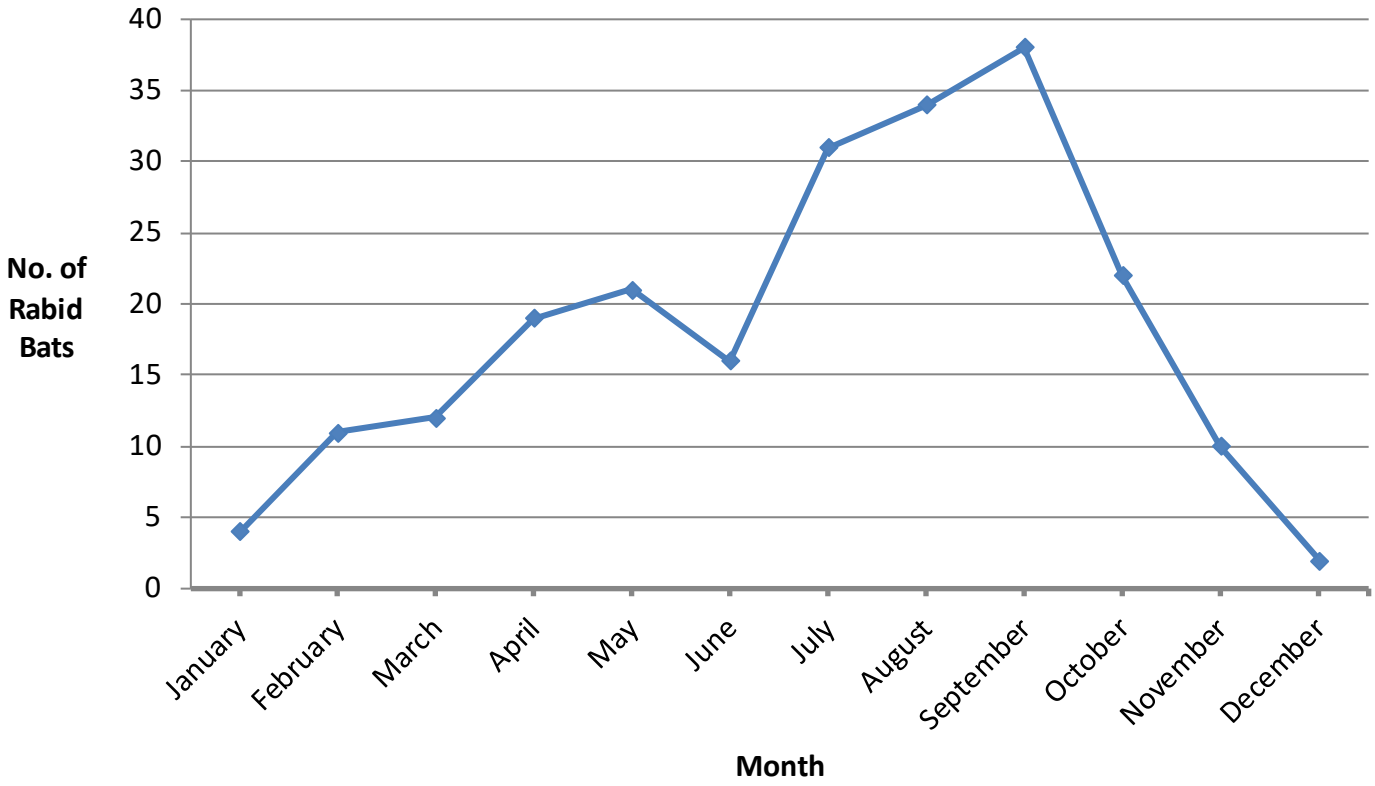

Figure E. Reported cases of rabies in wild animals by zip code of collection site, California, 2020.