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# THE CURRENT STATUS OF WILD ANIMAL RABIES IN CALIFORNIA

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During the 15-years 1952-1966, a total of 3504 cases of animal rabies were reported in California, an average of over 230 cases annually (Table 1). Of these 3504 cases, 2255 or nearly 65 percent were reported in wildlife species.

An estimate sometimes used is that for every reported or recognized case of wild animal rabies, 10 cases probably occurred without recognition. Using the foregoing "rule-of-thumb", it can be hypothesized that during the 15-years 1952-1966, an estimated 22,600 or more cases of wildlife rabies occurred in California. The addition of the over 1200 cases of rabies reported in domestic animals during the same period provides an estimated total of nearly 24,000 cases of rabies in all species or an annual average of nearly 1600. These figures, while estimates, emphasize more clearly, the extent of the reservoir of rabies in California wildlife than do reported figures and emphasize as well the long period of time, over 13 years, during which the problem has persisted (Table 1).

The occurrence of rabies in California wildlife is not a new phenomenon. The early recorded incidence of the disease in wild animals in the State, however, certainly does not compare with what has been observed here since 1954. The book Fur Bearing Animals contains an article reprinted from the Amer. Jour. Sci. and Art for May, 1874, entitled "Rabies Mephitica" in which the author, Reverend Horace C. Hovey', in a footnote makes reference to the occurrence, ostensibly in California, of a disease in man like hydrophobia following bite by the spotted skunk Spirogale putorius.

A further reference is the relating by Nelson in his book Wild Animals of North America of instances of transmission of rabies from the spotted skunk to man in Arizona in 1910 and on Cape San Lucas on the tip of Lower Baja California in 1905. Nelson notes also that when the voyager Duhun-Cilly visited Cape San Lucas in 1826, the natives feared the spotted skunk because they entered houses at night, biting people and infecting them with hydro - phobia.

The above references indicate that rabies on the Pacific Slope antedates by over 75 years the first laboratory confirmation of the disease made in California in a dog in Los Angeles in 1898.

While the presence of rabies in wild animals had been hypothesized and suggested as a source of the disease occurring in dogs in Los Angeles in 1898[2-4], the first reference to laboratory confirmation of rabies in a wild animal in California is that by Sawyer[5] to the finding of Negri bodies in the brain of a large grey fox killed in the mountains of Ventura County in April 1912. No further recognition of rabies in wildlife was made until April 1913 when the State Hygienic Laboratory reported a rabid coyote from Tulare County[5].

The next diagnosis of wild animal rabies was reported by the above laboratory in March 1915 when the brains of two coyotes from Lake County, Oregon, were found positive[6]. It was only a short time, October 1915, until the disease was confirmed in 3 coyotes from Modoc and Lassen Counties in Northeastern California. During the ensuing months of 1915-1917, an extensive outbreak of coyote rabies occurred in Modoc, Lassen and adjoining counties. Other wildlife species and domestic livestock were seriously involved. From October 1915 through December 1917, 209 animals from 8 Northeastern California counties were confirmed rabid by the State Hygienic Laboratory. These 209 cases consisted of coyotes-95, cattle-64, dogs-31, sheep-8, horses-6, bobcats-3, cats-1 and goats-1.

The above figures for laboratory confirmed cases while large, are not indicative of the actual extent outbreak for only a small proportion of the affected animals were shipped to the laboratory. It is reported, however, that livestock owners in Lassen and Modoc Counties alone lost an estimated $150,000 worth of cattle and horses as a direct result of the outbreak.[7]

During the control campaign carried out in Modoc County (12/3/15 - 6/30/16), and in Lassen County (1/3 - 6/30/16), 7162 coyotes, 1091 dogs, 790 cats, 430 bobcats and 496 skunks were killed and a total of 66,910 poison baits placed[8-9]. The outbreak in North-

eastern California, while extensive in itself, constituted only a portion of an outbreak of coyote rabies which simultaneously involved the neighboring areas of Southeastern Oregon, Northern Nevada, Southern Idaho and Northwestern Utah.[10] A subsequent outbreak of coyote rabies in Northern Baja California in 1958-1959 has had serious ramifications for California and will be discussed later.[11 12]

The period 1919-1951 in California, constituted a 33-year era during which dog rabies was widespread throughout the State. While exact figures are not available on species rabid in California for part of the three years 1919-1921, reporting during the 30-year period 1922-1951 show that 18,952 cases or 92 percent of the total of 20,485 cases reported were in dogs. During the same period, only 147 cases or 0.7 percent of the total were reported in wild animals. Only in five instances during the 30-year period did the number of rabies cases reported in wildlife exceed 6 cases per year (1923 - 11 cases, 1947 - 7, 1949 - 8, 1950 - 28 and 1951 - 10).

In retrospect, the increased incidence of the disease reported in wild animals in 1947, 1949-1951 and 1952-1953 gave warning of the development of the current sylvatic rabies problem which materialized in 1951-1955. It is the current problem of the disease in wildlife since 1954 with which this paper is concerned.

It should be stated that the term "current status" as used here includes the total 13-year period 1954-1966 as well as the future or balance of the wildlife rabies cycle through which we are now passing. To those who may question such a definition, it should be understood that rabies in wildlife occurs as long term cycles extending over many years, covering large geographic areas, and that these cycles of the disease in wildlife alternate with long periods of apparent freedom.

The long term cycles of rabies in wildlife are little understood. However, study of the ecology of rabies in various parts of the world indicates that in certain regions,[13] sporadic cases of rabies occur in wild carnivores at fairly frequent intervals.[13] At longer intervals the occurrence of such sporadic cases is followed by migrating epidemics of the disease in wildlife. Johnson[13] is of the opinion that it is the regions which exhibit repeated instances of sporadic cases of rabies in wildlife which must contain a reservoir host. No true reservoir host, however, has yet been identified although Johnson[13-14] has hypothesized that the families Mustelidae and Virverridae seem to form the common denominator as regards to the species which conceivably could serve to perpetuate the disease. The long term cycles of rabies are made up of numerous localized epizootics alternating with periods of endemicity and periods of apparent freedom. Local areas involved vary from large to small and those affected at any particular time vary from year to year.

The virus causing rabies is an opportunist obligate parasite requiring a living host to survive and utilizing the natural defense mechanism of biting of the various carnivorous species to propagate itself from one host to the next. The sylvatic cycle of the disease is the natural and historic cycle and constitutes a continuing source of infection for wildlife species not involved in maintaining the disease in an area and for domestic livestock, pets and directly and indirectly for man.

The domestic dog can be considered an aberrant host. However, when the virus succeeds in transmission to a susceptible dog population with subsequent dog-to-dog transmission, a new epizootic results. An example is the California-Baja California Border canine rabies epizootic of 1959-1960.[11-12]

The current occurrence of rabies in wildlife in California is not unique for a similar rabies phenomenon has emerged in other areas during the same period and is being observed over much of the United States. In California, the slight increase in reported cases of rabies in wildlife observed during 1947-1953, materialized into a major problem during 1954-1955 (Table 1) and has remained so through the present day. The number of cases reported in wildlife in California during the period since 1955 have ranged from 98 (1960) to 280 (1964) with an average of 182 cases per year. A total of 53 counties have reported cases of rabies in wild animals during the period 1954-1966. The number of counties reporting cases annually in wildlife has ranged from 20 (1954 to 42 (1963).

Wild species most commonly affected have been the skunk (1730), bat (342), and fox (131) during the period 1952-1966. Other species totals were bobcat (24), coyote (14), racoon (9), badger (3) and opossum and weasel (one each).

The distribution of reported cases of wild animal rabies in California is similar for all species with the exception of that for bats which is practically statewide (Maps 1-5). The wildlife disease in species other than bats is one affecting primarily the two main river valleys (San Joaquin and Sacramento) and the Coastal Range and valleys. The disease in the San Joaquin and Sacramento Valleys extends into the foothills of the Sierra Nevada Range but with cases being limited to areas below snowline. The Northern and Northeastern California counties (Del Norte, Si ski you, Lassen, Modoc and Plumas)and of the Sierra Nevada Range (Alpine, Mono and Inyo) have not reported cases with the exception of one rabid coyote from Death Valley, Inyo County in 1962. Counties reporting cases In skunks during the period 1952-1966 have numbered 41, in foxes - 26, bobcats - 9, bats - 49.

Canine rabies for the most part has not constituted a problem in California since 1958 with the exception of the areas of Imperial and San Diego Counties immediately adjacent to the Mexican Border (Table 2). The lack of adequate canine rabies control in Mexico has resulted in repeated introductions of the disease via infected stray dogs crossing the Border into California, Figures emphasizing severity of the problem are available from the Port-of-Entry, Calexico, Imperial County, where a 24-hour dog guard has been maintained since January 22, 1964, to prevent the entry of stray dogs from Mexico. During the nearly 36 month period January 22, 1964, through December 31, 1966, a total of 287 stray dogs were apprehended coming through the gate area from Mexicali and examined for rabies. Of these 287 strays, 27 or 9.4 percent were positive for rabies. During 1964, positive animals constituted nearly 30 percent of those examined.

The canine rabies problem in the Imperial-Mexicali Valley has existed since the Fall of 1959 and is of interest since the disease in dogs in the area had origin in an epizootic of coyote rabies in the mountainous and livestock raising areas of Baja California south of San Diego County and the Mexicali Valley in 1958-1959. It is probable that rabies in coyotes ranging into the Mexicali Valley infected dogs, and that dogs carried the disease into urban Mexicali and the Southern Imperial Valley.

In September 1962, rabies in dogs became a problem in Tijuana, probably as the result of traffic from the Mexicali Valley, The Tijuana problem quickly involved the South Bay area of the City of San Diego. The dog rabies problem in Baja California has continued to complicate control in California through the end of 1966. Hopefully, a cooperative program-between the United States and Mexico to establish continuing canine rabies control programs in the Northern States of Mexico which began in Baja California in September 1966 will soon alleviate the Border dog problem.

In the meantime, however, another outbreak of rabies in wildlife in Baja California which apparently began in the Fall of 1965, has involved South Central San Diego County. This new outbreak is predominately in foxes, with cases in bobcats, skunks and coyotes as well. From March 14, 1966, when the first case was found in San Diego County in a bobcat, through February 28, 1967, a total of 85 cases (fox - 58, bobcat - 14, skunk - 6, coyote - 5, stray domestic cat - 1 and stray dog - 1) have occurred in connection with the outbreak. A total of 8 trappers are working in a county-wide program to control the wildlife outbreak at an expenditure of close to $80,000 per year, cost of which is being borne by a combination of federal, state and county funds.

The reported incidence of the disease in foxes and bobcats in the San Diego County outbreak is unprecedented in the history of the State. For the first time since 1915-1916 in Modoc and Lassen County, a county-wide quarantine has been invoked in California for the purpose of control of rabies in wildlife. The San Diego County outbreak is of concern to California for it is conceivable that the disease in foxes may move northward and seriously involve other areas of the State.

The situation with regard to wildlife rabies in California is not particularly good. The wildlife problem has been the justification for the State to require institution of adequate canine rabies control and preventive measures by the cities and counties throughout the affected areas of the State.[16] As a result, canine rabies control and prevention is an adequately organized program which has successfully controlled and prevented rabies in dogs in the face of an unprecedented problem of the disease in wildlife.

Despite the existence of a high incidence of wildlife rabies throughout the major portion of California since 1955, however, the State still lacks today an organized program for its control. The basic reason for the lack of application of organized wildlife rabies control measures is the lack of authorized State funds. Where sylvatic rabies control work

has been done, funding has been almost solely by the counties concerned.

There exists, however, an organization capable of conducting needed sylvatic rabies control work. This organization presently conducts a 41 county program of predator control for the purpose of livestock protection. The program is administered by the Division of Wildlife Services, Bureau of Sport Fisheries and Wildlife, U. S. Department of the Interior in cooperation with the California Department of Agriculture and the various participating counties. Funding for the program is divided three ways using federal, state and county monies.

Division of Wildlife Services funds at the present time can be used to provide service for both livestock protection and wildlife rabies control work. The uses of county funds are determined by the boards of supervisors. However, California Department of Agriculture funds are limited by Legislative appropriation to use for livestock protection. In the past 10 years, the nature of wildlife management work in many counties has shifted in varying degree to where at the present time in the State as a whole, the level of work needed for wildlife rabies control is estimated to equal that required for livestock protection purposes. In many areas, dual work is required, i.e., both livestock protection and sylvatic rabies control. In some areas, only livestock protection is required whereas in others the work needed is almost totally wildlife rabies control.

There is a definite need for State participation in wildlife rabies control for the purpose of providing the continuity and coordination of program effort which is lacking in California at the present time. Sylvatic rabies is more than just a county problem. The disease in wildlife does not recognize county boundaries. Many of the areas where control is needed are more urban than rural, e.g., Eastern Sacramento County and Ventura, Los Angeles, Santa Clara, Contra Costa, Marin and Napa Counties. In a number of instances, skunk rabies control has involved work within corporate city limits.

Under existing conditions, some areas feel compelled to initiate wildlife rabies control measures and appropriate the necessary funds. Adjoining areas where control work may also be needed, however, may or may not appropriate monies for control.

The lack of coordination in determining need and the lack of funds are the major problems. The appropriation of funds by the State Legislature for both livestock protection and wildlife rabies control within the organizational framework of the existing livestock protection program administered by the Division of Wildlife Services and the California Department of Agriculture.

The duration, of the current cycle of wildlife rabies in California cannot be predicted. However, past cycles of the disease in skunks, e.g., in the 1870's in the great plains area of the mid-west lasted approximately 30 years. The present situation in California could be similar. The overall problem could be further complicated and prolonged by involvement of the fox and bobcat populations at a future time in a manner similar to what is currently occurring in San Diego County.

With canine rabies under control in California and with the implementation of continuing dog rabies programs in Baja California, it is only logical that effort be undertaken to cope with the disease in wildlife. There are few areas of the State where one can venture to sleep on the ground in the open without protection without risking exposure to rabies. The risk of a rabid skunk getting into a sleeping bag at night while still occupied by the owner is a real hazard.

Two individuals have died of rabies contracted in California from skunks since 1952. One, a boy, died in Oklahoma following exposure in a field in Fresno County in 1952. The other, a woman, died after being bitten in Tulare County in 1954 by a skunk which entered a tent where she was sleeping. A similar and more recent incident occurred in South Dakota where a 10 year old boy died of rabies on September 5, 1966. On August 3, the boy had been sleeping in his own backyard in a sleeping bag. He was awakened when a striped skunk bit him after apparently crawling into the sleeping bag.[15]

Rabies in bats which was first identified in the United States in Florida in 1953 and in California in 1954 is prevalent throughout the country. While one woman bitten in 1958 in Butte County, California, died of rabies[17-18], there is no epidemiologic evidence that bat rabies plays a role in the maintenance and transmission of rabies in wild or domestic animals in the United States. There also is no evidence that insectivorous bats are carri-

ers of rabies. The majority of cases found in bats involve the individual which is partially paralyzed and unable to fly. If people, particularly young children, can be taught to avoid picking up and handling sick and partially paralyzed bats, relatively few persons would be exposed to rabies from such a source. This is more a matter of education than control.

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**TABLE 1. REPORTED CASES OF ANIMAL RABIES BY SPECIES - CALIFORNIA, 1952 - 1966**

| | TOTALS | 1966 | 1965 | 1964 | 1963 | 1962 | 1961 | 1960 | 1959 | 1958 | 1957 | 1956 | 1955 | 1954 | 1953 | 1952 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOTALS | 3504 | 308 | 229 | 328 | 306 | 253 | 253 | 123 | 166 | 173 | 197 | 302 | 425 | 85 | 174 | 142 |
| DOMESTIC | | | | | | | | | | | | | | | | |
| SP. | 1245 | 44 | 39 | 46 | 93 | 68 | 36 | 25 | 54 | 12 | 57 | 177 | 259 | 41 | 161 | 126 |
| Dog | 1010 | 24 | 18 | 36 | 86 | 46 | 20 | 14 | 34 | 4 | 49 | 141 | 246 | 34 | 155 | 103 |
| Bovine | 156 | 14 | 17 | 8 | 6 | 12 | 13 | 8 | 15 | 6 | 5 | 28 | 9 | 4 | 3 | 8 |
| Cat | 51 | 4 | - | 2 | 1 | 7 | 2 | 1 | 2 | 2 | 3 | 6 | 3 | 1 | 3 | 15 |
| Equine | 24 | 2 | 4 | 2 | 5 | 3 | 1 | 2 | 3 | - | - | 1 | - | 1 | - | - |
| Sheep | 1 | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |
| Goat | 2 | - | - | - | - | - | - | - | - | - | - | 1 | 1 | - | - | - |
| Swine | 1 | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| WILDLIFE | | | | | | | | | | | | | | | | |
| SP. | 2255 | 264 | 190 | 280 | 208 | 225 | 216 | 98 | 112 | 161 | 140 | 125 | 166 | 44 | 13 | 13 |
| Skunk | 1730 | 154 | 113 | 208 | 145 | 185 | 174 | 83 | 82 | 146 | 130 | 119 | 141 | 32 | 6 | 9 |
| Bat | 342 | 54 | 72 | 53 | 53 | 29 | 34 | 12 | 18 | 8 | 2 | 4 | 2 | 1 | - | - |
| Fox | 131 | 42 | 2 | 14 | 5 | 4 | 3 | 2 | 8 | 7 | 7 | 2 | 19 | 6 | 6 | 2 |
| Bobcat | 74 | 10 | 2 | 1 | 4 | - | - | - | 1 | 1 | - | - | 3 | 2 | - | - |
| Coyote | 14 | 4 | - | 2 | 1 | 1 | 3 | 1 | 1 | - | - | - | - | - | - | 1 |
| Racoon | 9 | - | - | 1 | - | 1 | 2 | - | 1 | - | 1 | - | 1 | 1 | 1 | - |
| Badger | 3 | - | - | 1 | - | 1 | - | - | 1 | - | - | - | - | - | - | - |
| Opossum | 1 | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Weasel | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| Other | 4 | - | - | - | - | - | 1[a] | - | - | - | - | - | - | - | - | 3[b] |

a - Monkey from out-of-country
b - Three gophers, probably not rabies
SOURCE: State of California, Department of Public Health Morbidity Reports CD-77.

**TABLE 2. REPORTED CASES OF RABIES IN DOGS WITH PROPORTION OCCURRING IN MEXICO BORDER AREA AND IN THE BALANCE OF THE STATE, CALIFORNIA, 1955 - 1966**

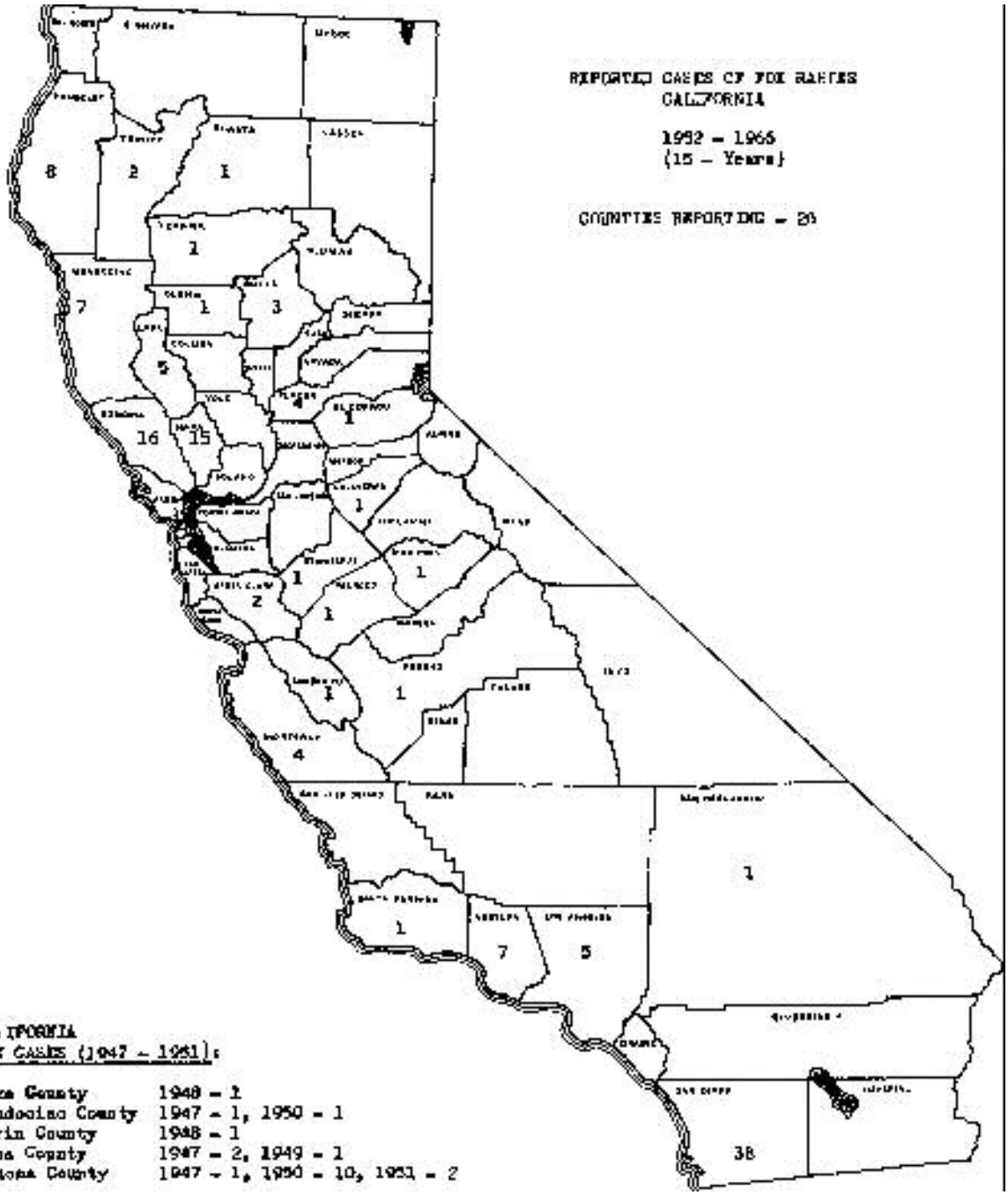
| | REPORTED CASES OF RABIES IN DOGS | | |
|---|---|---|---|
| YEAR | CALIFORNIA TOTALS | CASES IN MEXICO BORDER AREA[a] | CASES IN BALANCE OF CALIFORNIA |
| TOTALS | 718 | 253 | 465 |
| 1955 | 246 | None | 246 |
| 1956 | 141 | None | 141 |
| 1957 | 49 | None | 49 |
| 1958 | 4 | None | 4 |
| 1959 | 34 | 29 | 5 |
| 1960 | 14 | 10 | 4 |
| 1961 | 20 | 15 | 5 |
| 1962 | 46 | 45 | 1[b] |
| 1963 | 86 | 84 | 2 |
| 1964 | 36 | 34 | 2 |
| 1965 | 18 | 16 | 2 |
| 1966 | 24 | 20 | 4 |
| SUB-TOTALS | | | |
| 1958-1966 | 282 | 253 | 29 |

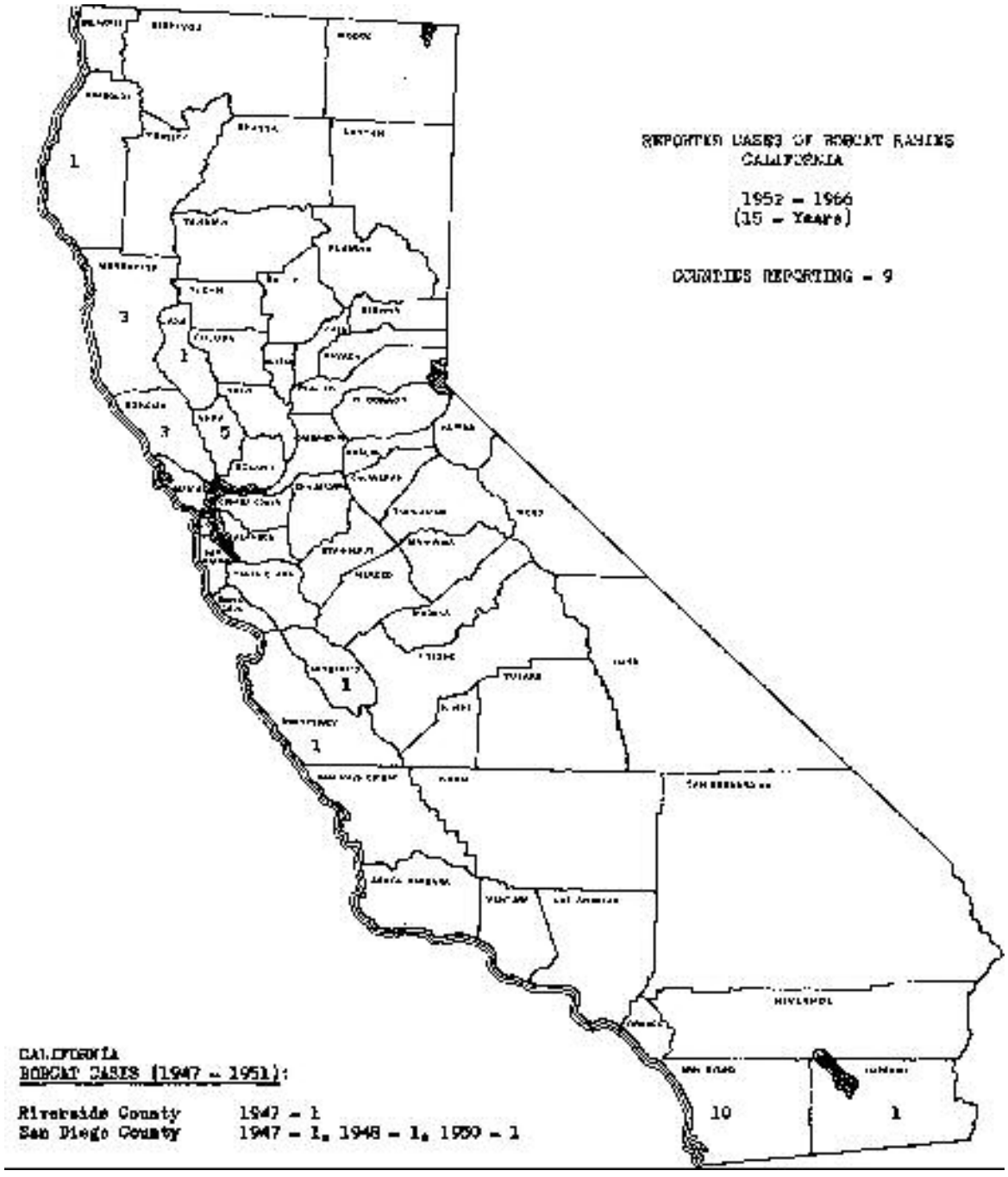
a - Mexico Border area: Imperial and San Diego Counties.
b - Dog in Butte County developed rabies 5 days after return from 7-week stay in Mexico.
SOURCE: State of California, Department of Public Health, Morbidity Reports CD-77.

MAP 1


REPORTED CASES OF SKUNK RABIES
CALIFORNIA
1952 - 1966
(15 - Years)
COUNTIES REPORTING - 41
23
14
28
32
21
25
30
30
22
20
33
12
18
61
05
197
40
39
25
11
26
04
115
68
33
4
35
36
41
17
9
29
19
71
26
2
134
130
4

MAP 2

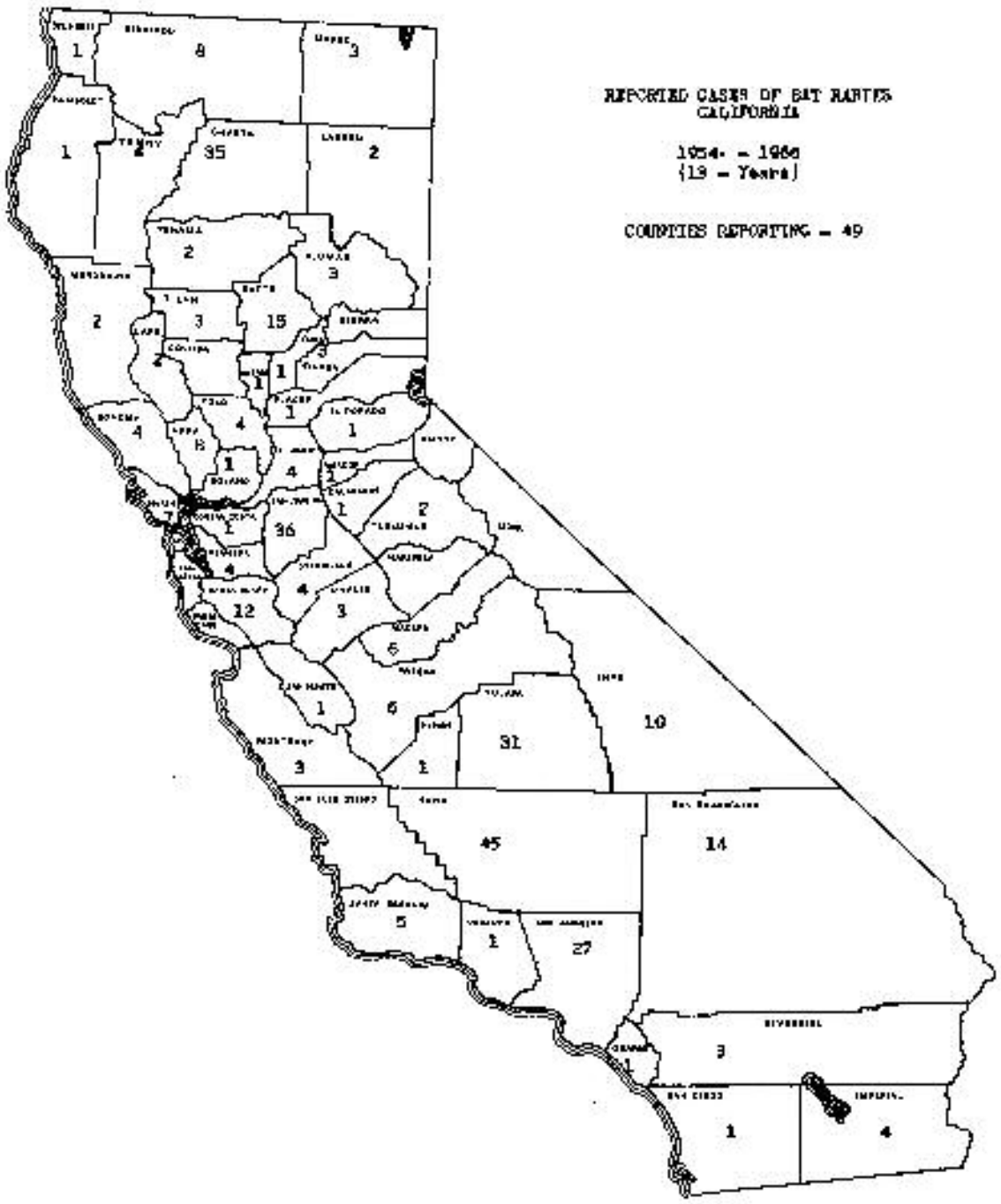

REPORTED CASES OF FOX RABIES
CALIFORNIA
1952 - 1965
(15 - Years)
COUNTIES REPORTING - 26
CALIFORNIA
FOX CASES (1947 - 1951):
Lake County 1948 - 1
Mendocino County 1947 - 1, 1950 - 1
Marin County 1948 - 1
Napa County 1947 - 2, 1949 - 1
Sonoma County 1947 - 1, 1950 - 10, 1951 - 2




CALIFORNIA
BOBCAT CASES (1947 - 1951):

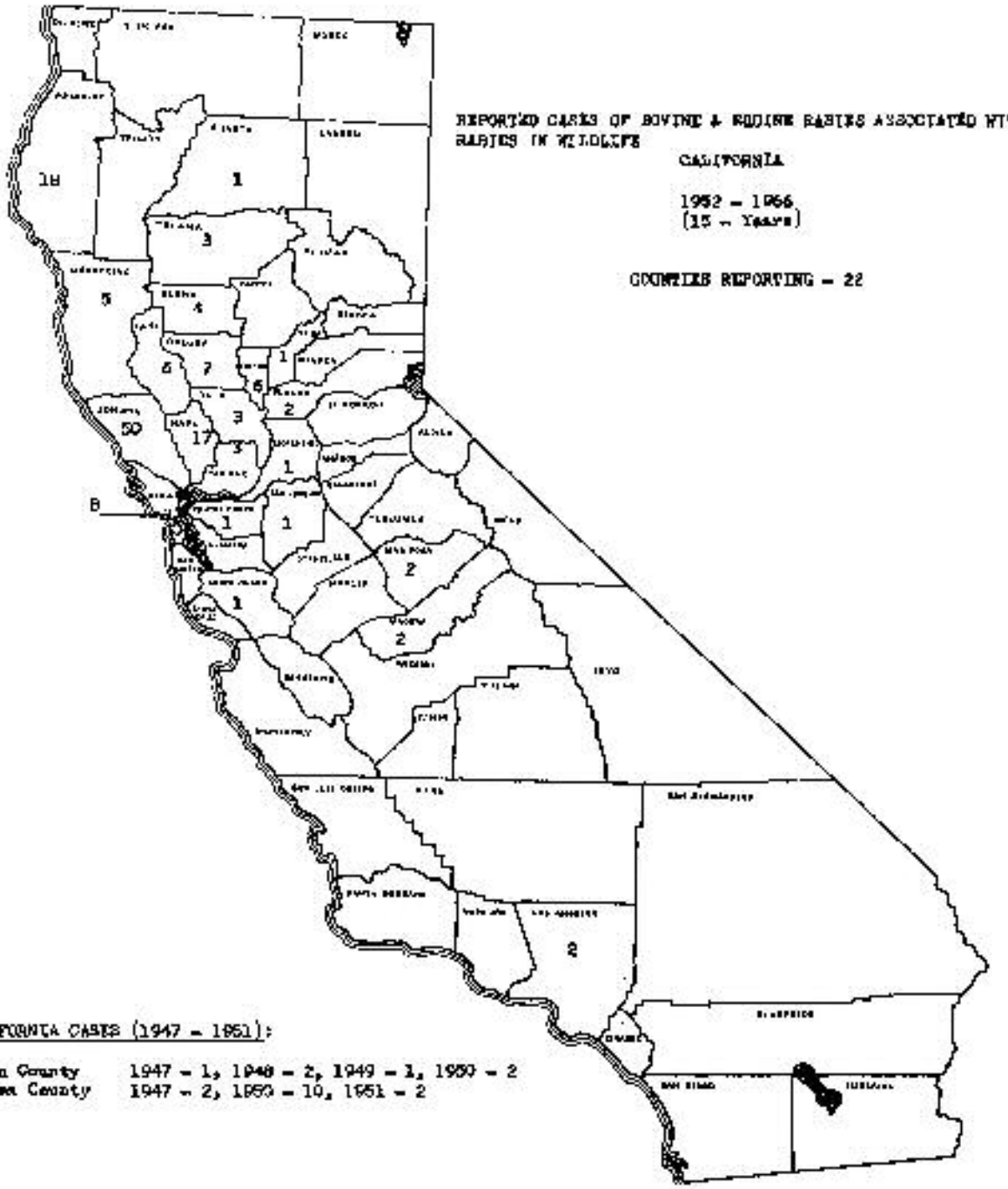
Riverside County 1947 - 1
San Diego County 1947 - 1, 1948 - 1, 1950 - 1

**MAP 4**

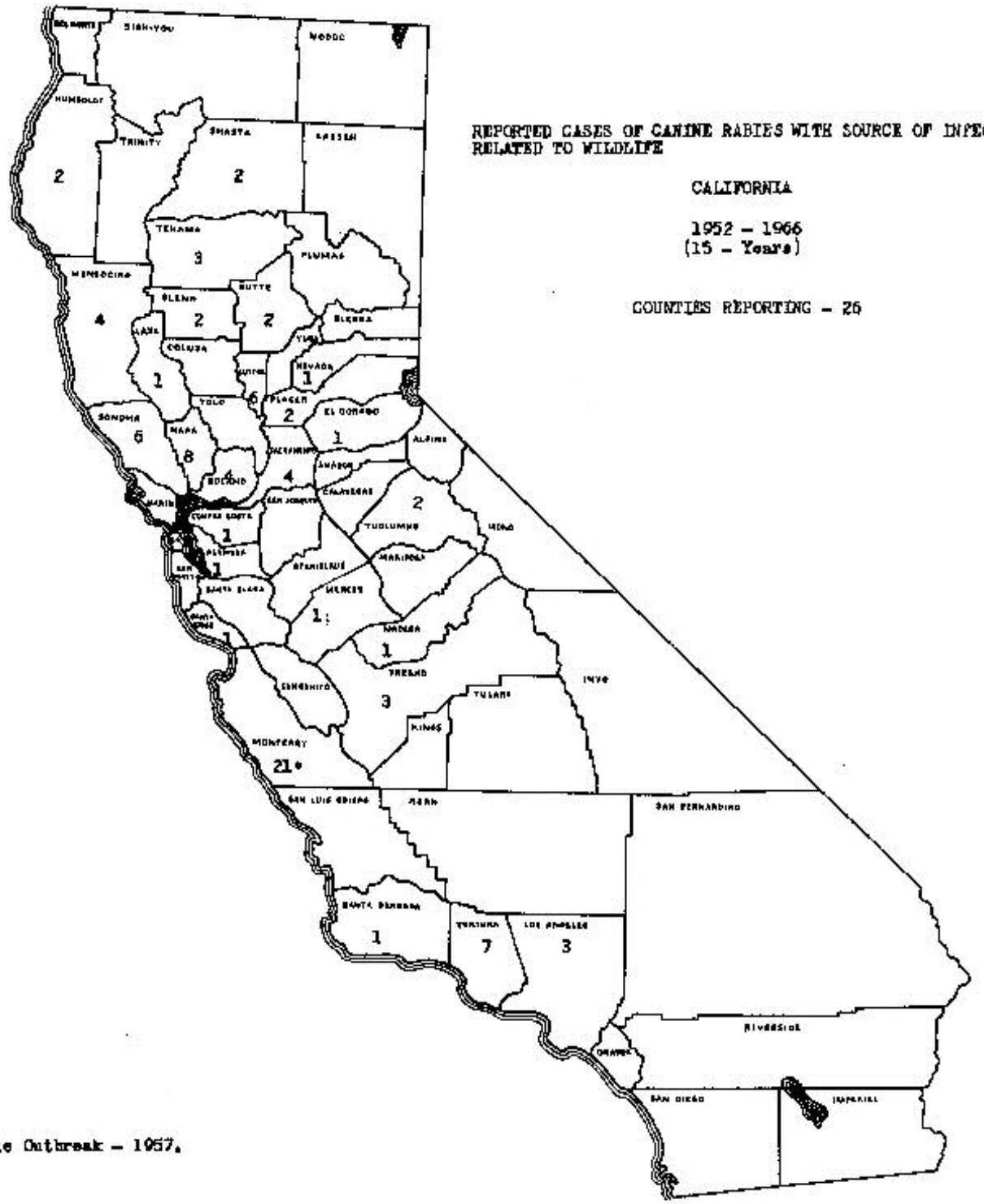



*First reported case, Sonoma County, 1954.

**MAP 5**


REPORTED CASES OF BOVINE & EQUINE RABIES ASSOCIATED WITH RABIES IN WILDLIFE
CALIFORNIA
1952 - 1966
(15 - Years)
COUNTIES REPORTING - 22
CALIFORNIA CASES (1947 - 1951):
Marin County 1947 - 1, 1948 - 2, 1949 - 1, 1950 - 2
Sonoma County 1947 - 2, 1950 - 10, 1951 - 2

MAP 6


REPORTED CASES OF CANINE RABIES WITH SOURCE OF INFECTION RELATED TO WILDLIFE
CALIFORNIA
1952 – 1966
(15 – Years)
COUNTIES REPORTING – 26
•Single Outbreak – 1957.