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Rabies Surveillance, United States, 1988

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Summary

The primary purpose of the annual report on rabies surveillance is to assist local and state public health officials in the planning of rabies control programs and to guide health professionals in evaluating the need for rabies postexposure prophylaxis in patients who are exposed to animals that may be rabid. In 1988, a total of 4,724 cases of animal rabies were reported by 47 states, the District of Columbia, and Puerto Rico, similar to the total (4,729) for 1987. No human cases of rabies were reported.

The South Atlantic, South Central, North Central, and Middle Atlantic states reported 81% of the cases. Pennsylvania, Texas, California, Maryland, and Virginia each reported over 300 rabid animals. Delaware (61 cases), New Mexico (15), Alaska (34), Connecticut (8), and South Carolina (127) each reported an increase in animal rabies cases ≥ 100% in 1988 compared with 1987. Smaller but significant increases also were reported from Florida (66% increase), Pennsylvania (68%), and Georgia (40%).

Eighty-eight percent of rabies cases were in wild animals, and 12% were in domestic animals. Skunks, raccoons, and bats accounted for 82% of all rabid animals. Cats became the most commonly reported domestic species for the first time since reporting to CDC began in 1960.

The most effective methods of reducing the number of people exposed to rabies are to educate the public to avoid unfamiliar, especially wild, animals and to vaccinate susceptible pets against rabies. Rabies vaccination programs should target cats as well as dogs. Two cases of imported canine rabies emphasized the need to educate travelers of the risk of canine rabies in developing countries. Caution should be used when pets are imported from these countries.

INTRODUCTION

Since the 1950s, canine vaccination and programs on stray-dog control have dramatically decreased rabies in domestic animals (Figure 1) and people. For example, in the 1950s, an average of 11 persons (range: 4-20) died of rabies every year in the United States, and all were exposed to rabies by contact with native animals (Figure 2). In contrast, from 1980 through 1988, an average of one person (range: 0-3) per year acquired rabies, and 73% of these persons were exposed to rabies by contact with animals outside the United States.

The number of rabid wild animals exceeded that of domestic species in 1960 and increased dramatically during the late 1970s and early 1980s (Figure 1). Whether the case count represented an actual increase in the incidence of rabies in wildlife or an increased testing of wildlife is unclear; however, at least four major epizootics in wild animals have been documented. The increase in the late 1970s was a result of two epizootics of rabies in skunks, one centered in the North Central and one in South Central states (Figure 3). Two separate epizootics occurred in raccoons in West Virginia and Virginia. One began in Florida, Georgia, Alabama, and South Carolina, and the other, which began in 1977, eventually spread to several other Middle Atlantic and South Atlantic states (*1*). Since 1980, the most commonly reported rabid wild animals have been skunks, raccoons, bats, and foxes.

An increase in rabies in domestic animals was also observed in the early 1980s, probably as a result of the increase in rabid wildlife (Figure 4). Since 1980, the most commonly reported rabid domestic animals have been cats, cattle, and dogs.

On the basis of reaction patterns to a panel of monoclonal antibodies against the rabies virus, virus isolates from rabid animals can be grouped into ecotypes (*2*). Accordingly, five major distinct ecotypes of the rabies virus exist in animals in the United States (Figure 5). In each of these areas, the virus ecotype circulates in the main reservoir of the area but occasionally extends to other species.

Because of Canada and Mexico's proximity to the United States, data from these countries are included in a separate section of this report.

METHODS

All cases of animal rabies reported to CDC had been diagnosed by state or territorial health department laboratories. Suspected rabid animals were submitted for a variety of reasons to health department laboratories by local health officials, veterinarians, animal-control officers, and the public. Almost all diagnoses of animal rabies were based on a positive result on direct fluorescent-antibody testing of brain tissue. Rabies virus isolation in mice or in tissue culture (e.g., neuroblastoma cells) was sometimes used to confirm fluorescent-antibody tests. In addition, virus isolates were occasionally sent to CDC for ecotype analysis with the use of monoclonal antibody techniques (*2*).

Most state and territorial health departments reported cases of animal rabies by sending a monthly summary of cases stratified by species and county of origin. Some states submitted these data as part of the Electronic Surveillance Project (ESP), a CDC computerized surveillance network. The accuracy of all data was confirmed.

Data were stratified by species and by the state in which the animal was captured. Data from 1988 were compared with surveillance data from 1987 (*3*). For the geographic distribution of cases, states were grouped into eight divisions.

Data from Canada were obtained from the Animal Health Division, Canadian Department of Agriculture. Data from Mexico were obtained from the Direccion General de Medicina Preventiva, Secretaria de Salud.

Interpretation of Data

Surveillance data should be interpreted with an understanding of the general and area-specific limitations of the surveillance system. All laboratory-confirmed cases of animal rabies are reported to CDC, but not all rabid animals are submitted to state health departments. Incidence rates cannot be calculated from rabies surveillance

data because the animal populations are unknown. Therefore, the number of reported cases should be considered only a *crude estimate* of the risk of rabies in an animal species from a particular area.

Decisions on the management of patients or animals exposed to rabies should be made in consultation with appropriate local and state health officials. The decision of whether to use rabies postexposure prophylaxis in a patient exposed to rabies by contact with a suspected rabid animal that is unavailable for testing depends on 1) the circumstances of the exposure and 2) the species-specific risk of rabies in that area (*4*).

Detecting the true distribution of rabies in an area depends on the sensitivity of the surveillance system. The sensitivity of animal rabies surveillance varies among states because state health department laboratories have different criteria for accepting a specimen for testing. For example, many laboratories will test only those animals to which persons or domestic animals have been exposed. Many rabid animals, especially wildlife, never expose a human being or domestic animal and, therefore, remain undetected. In addition, the sensitivity of the surveillance system may vary within a state. For example, the number of examinations of animals may vary among counties because of availability of local animal-control services and transportation to state laboratories. Finally, the proportion of reported cases by species may not reflect the true distribution of rabies in animals, since certain animals are more likely to be captured for testing. For example, dogs are more likely to be captured and tested than wild animals such as bats.

RESULTS

Rabies in the United States and Its Territories

In 1988, a total of 4,724 cases of animal rabies were reported by 47 states, the District of Columbia, and Puerto Rico (Figure 6, Table 1). This total is essentially the same as in 1987 (4,729). No human cases of rabies were reported.

The South Atlantic, South Central, North Central, and Middle Atlantic states reported 81% of the cases (Figure 7). Pennsylvania, Texas, California, Maryland, and Virginia reported the most cases, each reporting at least 300 rabid animals (Table 1). Delaware (61 cases), New Mexico (15), Alaska (34), Connecticut (8), and South Carolina (127) each reported an increase in animal rabies cases $\geq$100% in 1988 compared with 1987 (Table 1). Smaller increases also were reported from Florida (66% increase), Pennsylvania (68%), and Georgia (40%). Rhode Island (no cases) was the only state to report $\geq$100% decrease in rabid animals.

Rabies was relatively rare in New England and absent in the U.S. territories except for Puerto Rico. Although Hawaii, Rhode Island, and Vermont did not report any cases in 1988, Hawaii is the only state considered to be free of rabies. Puerto Rico reported 73 cases of animal rabies in 1988; 71% were rabid mongooses. The other U.S. territories of Guam, the Virgin Islands, American Samoa, and the Commonwealth of the Northern Mariana Islands are rabies-free areas (*5*).

The distribution of rabid animals by species was similar to that in 1987. Eighty-eight percent of cases were in wild animals, and 12% were in domestic animals (Figure 8). Skunks, raccoons, and bats accounted for 82% of all rabid animals. The only notable increase was in rabid foxes. In domestic animals, the most notable change from the previous year was that the number of rabid cats exceeded that of

rabid cattle and became the most commonly reported domestic species for the first time since reporting to CDC began in 1960.

Although rabid animals were reported throughout the year, several species appeared to have seasonal peaks. Distinct peaks of activity in rabid skunks and cattle occurred in March and April, with the increase in rabid skunks preceding that of rabid cattle by approximately 1 month (Figures 9, 10). Most rabid bats and cats were reported during the summer and fall months. The number of rabid raccoons peaked in the spring and fall.

Rabies in Wild Animals

As in 1987, wild animals accounted for 88% of all rabid animals. Skunks were the most frequently reported rabid species in the United States, accounting for 38% of all rabid animals, followed by raccoons (31%), bats (14%), and foxes (4%) (Figure 8). Rabies in wildlife species was reported from all states except Hawaii and several states in New England (Table 1).

Skunks. Skunks were the most commonly reported rabid animal, although there was a 12% decrease in cases compared with 1987 and a 25% decrease compared with 1986 (*3*). The distribution of cases (Figure 11) was similar to that of 1987 with the South Central states, North Central states, and California reporting 73% of cases. Delaware (7 cases), New Mexico (6), South Carolina (10), and Indiana (26) reported ≥100% increase in rabid skunks compared with 1987 (*3*).

Raccoons. Reports of rabid raccoons increased 12% in 1988 compared with 1987; raccoons were the second most commonly reported rabid animal. Of 1,465 cases, 99% were reported from states involved in one of the two raccoon epizootics (Figure 12, Table 1). The "mid-Atlantic" epizootic, involving the Middle Atlantic and South Atlantic states of Delaware, Maryland, Pennsylvania, Virginia, West Virginia, and the District of Columbia, reported 65% of all rabid raccoons, and the other "southeastern" epizootic, involving the South Central and South Atlantic states of Alabama, Florida, Georgia, and South Carolina (hereafter referred to as the "southeastern states"), reported 34%. The 498 cases reported in the southeastern states represent a 50% increase from 1987. There was virtually no change in the number of rabid raccoons reported from the mid-Atlantic epizootic. Although all of the southeastern states reported an increase in rabid raccoons, Florida and Georgia reported the greatest increase (79% and 43%, respectively). In the mid-Atlantic epizootic, cases occurred predominantly in southeastern Pennsylvania and northern Delaware (Figure 13). In addition, the outbreak spread south into southeastern Virginia.

Bats. Bats were the third most commonly reported species, accounting for 14% of all rabid animals (Table 1). There was only a 1% increase compared with 1987. Bats were the most widespread rabid animal, and rabies from bats was reported from 42 states (Figure 14). Ten states did not report any rabid animals except for bats. Eighty-eight percent of rabid animals from New England were bats.

Foxes. Although the proportion of rabies in foxes (4%) was low compared with that in other wild animals, foxes accounted for one of the largest increases (53%) in wildlife species in 1988 (Table 1). This increase was mainly a result of a 357% increase in rabid foxes in Alaska. The distribution of rabid foxes was otherwise similar to that of rabid skunks (Figures 15, 11).

Other wild animals. Mongooses accounted for most of the other wild animals, and their distribution was limited to Puerto Rico. Although the number of rabid rodents doubled in 1988, rodents accounted for less than 1% of all rabid animals. Of the 22 rabid groundhogs reported, all were from states involved in the mid-Atlantic epizootic.

Rabies in Domestic Animals

There were 550 cases of rabies in domestic animals in 1988, a 2% decrease from 1987 (Table 1). Rabies in domestic animals was usually reported only from states with large numbers of rabid terrestrial wild animals. For example, the North Central and South Central states accounted for 62% of rabies in domestic animals (Table 1). The most commonly reported rabid domestic animals were cats, cattle, and dogs.

Cats. Cats accounted for the greatest proportion (35%) of rabies in domestic animals for the first time. The 192 rabid cats represented a 16% increase from 1987. States that experienced an increase in cases ⩾100% compared with 1987 included Pennsylvania, Maryland, South Carolina, and Florida (*3*). The distribution of rabid cats was similar to that of rabid skunks and raccoons (Figures 11, 12, 16). The South Atlantic, North Central, South Central, and Middle Atlantic states accounted for 90% of all cases.

Cattle. Thirty-one percent of rabid domestic animals were cattle. The number of cases reported in 1988 (171) was similar to that reported in 1987. The North Central, South Central, and Middle Atlantic states reported 88% of all cases. Except for the absence of cases in the South Atlantic states, the distribution of rabid cattle was similar to that of rabid cats (Figures 16, 17).

Dogs. Dogs accounted for 23% of all rabid domestic animals. There were 128 cases of rabies in dogs reported in 1988, a 25% decrease from 1987. No substantial increases occurred in any state. The distribution of rabid dogs was also similar to that of the other domestic animals (Figures 16-18). The South Central, North Central, and South Atlantic states reported 84% of all cases.

In 1988, an outbreak of rabies in dogs and coyotes occurred in two Texas counties in the Lower Rio Grande Valley that had been free of rabies since 1970 (*6*). Monoclonal antibody studies indicated that the epizootic virus ecotype was identical to that found in Mexican dogs.

Imported canine rabies. In 1988, two dogs adopted in Mexico as pets were imported into the United States and subsequently developed rabies within several weeks of arrival. The first incident involved a young New Hampshire girl who adopted an unimmunized puppy while visiting Mexico (*7*). This adoption resulted in the treatment of 17 exposed persons. The second dog, a puppy that was too young for immunization, was brought into the United States by a family in Texas.

Other domestic animals. Other domestic species, such as horses, mules, sheep, goats, and swine, collectively accounted for 11% of rabid domestic animals. Seventy-three percent were horses or mules. Although there was more than a twofold increase in rabid swine, only seven rabid swine were reported.

Rabies in Canada and Mexico

Canada reported 2,284 laboratory-confirmed and 129 clinically diagnosed cases of animal rabies in 1988, an 18% decrease from 1987. The most commonly reported

rabid animals were foxes (45% of all cases), skunks (28%), cattle (14%), cats (4%), and dogs (3%); 76% of cases were reported from Ontario.

Mexico reported 74 human rabies deaths in 1988, a 21% increase from 1987. Ninety-two percent of the decedents had been bitten by rabid dogs. A total of 8,468 cases in animals were diagnosed clinically, and an additional 4,834 cases were diagnosed by laboratory testing. Dogs accounted for 93% of rabid animals; cats, for 2%; and bats, for 2%; 2% of the animals were of other species. Rabid animals were found in all areas in the country.

DISCUSSION

The most effective methods of reducing the number of people exposed to rabies are to educate the public to avoid unfamiliar, especially wild, animals and to vaccinate susceptible pets against rabies. Although domestic animals account for only 12% of all rabid animals, they account for 64% of all exposures requiring rabies treatment (*8*). Given that cats are now the most common rabid domestic animal, rabies vaccination programs should target cats as well as dogs.

Delaware, New Mexico, Alaska, Connecticut, and South Carolina reported the greatest relative increases in animal rabies in 1988. The increase in Delaware was due to continuing transmission among raccoons in one county that was initially affected by the mid-Atlantic epizootic in 1987. New Mexico had an increase in rabid skunks in several counties; this increase was possibly associated with an increase in the skunk population. Similarly, Alaska's increase was a result of periodic increases in rabid red foxes and fox populations in several areas. Connecticut's large percentage increase, however, was attributable to expected fluctuations in small numbers. In South Carolina, some of the increase was a result of a 29% increase in testing, possibly due to a new public-education campaign. Other increases reported by Florida, Georgia, and Pennsylvania were attributed to the spread of raccoon rabies in those states.

The mid-Atlantic outbreak began two decades after the southeastern epizootic (Figure 19) (*1*). Although the number of rabid raccoons in the mid-Atlantic epizootic has decreased steadily since 1983, the number of affected counties increases each year. In 1988, the sharp increase of rabid raccoons from the southeastern epizootic represented the largest relative increase (50%) in 10 years and may indicate further spread of this epizootic after several years of relative equilibrium. Further spread of the mid-Atlantic epizootic to highly populated areas of eastern Pennsylvania, Delaware, and New Jersey, where raccoons commonly live in close proximity to people, may result in large numbers of persons exposed to rabies. In 1987, the Delmarva Rabies Initiative, a cooperative of state and federal health, wildlife, and agriculture agencies, established a zone of immune raccoons by vaccinating raccoons along the Chesapeake and Delaware Canal to protect animal populations in the southern part of the Delmarva Peninsula. In 1988, two rabid raccoons were trapped within the zone, for the first time demonstrating that the epizootic had reached this area; however, no rabid animals were found south of the zone.

Transmission of rabies from one domestic animal to another rarely occurs in the United States. Dog-to-dog transmission may or may not be occurring in the two Texas counties. Nevertheless, this epizootic emphasizes the importance of maintaining high vaccination levels.

Monoclonal antibody analysis of rabies virus isolates from domestic animals have demonstrated that most domestic animals are infected by bites from the dominant

terrestrial wildlife reservoir in the area (*2*). The similar distribution of rabid domestic animals to skunks and raccoons suggests that skunks are the main source of rabies for domestic animals in the North Central and South Central states and that raccoons are the primary source in the Middle Atlantic and South Atlantic states. In addition, the distribution of rabid animals by month suggests that skunks are the primary source of rabies in cattle. The seasonal peaks of rabies in skunks, raccoons, and bats may reflect increased activity (e.g., during the mating season), increased likelihood of detection because of increased contact with people, or both.

The two cases of imported canine rabies emphasize the need to educate travelers of the risk of canine rabies in developing countries. Persons traveling to developing countries should use great caution when importing pets from these countries.

References

1. Jenkins SR, Winkler WG. Descriptive epidemiology from an epizootic of raccoon rabies in the middle Atlantic states, 1982-1983. Am J Epidemiol 1987;126:429-37.
2. Smith JS, Baer GM. Epizootiology of rabies: the Americas. In: Campbell JB, Charlton KM, eds. Developments in veterinary virology: rabies. Boston: Kluwer Academic Publishers, 1988: 267-99.
3. CDC. Rabies Surveillance, United States, 1987. In: CDC Surveillance Summaries, September 1988. MMWR 1988;37(No. SS-4):1-17.
4. Fishbein DB, Arcangeli S. Rabies prevention in primary care: a four-step approach. Postgrad Med 1987;82:83-95.
5. World Health Organization. World survey of rabies XXII [for years 1984-1985]. Geneva: World Health Organization, Division of Communicable Diseases, Veterinary Public Health Unit, 1987.
6. Zoonosis Control Division. Rabies in Texas. Zoonosis Update, February 1989:1-2.
7. CDC. Imported dog and cat rabies—New Hampshire, California. MMWR 1988;37:559-60.
8. Helmick CG. The epidemiology of human rabies postexposure prophylaxis, 1980-1981. JAMA 1983;250:1990-6.

TABLE 1. Cases of rabies, by state and category, United States, 1988

State	Total	Total domestic	Total wild	Dogs	Cats	Cattle	Horses/ mules	Sheep/ goats	Swine	Skunks	Foxes	Bats	Raccoons	Rodents and lagomorphs*	Other wild†	Percent change§
Species total	**4,724**	**550**	**4,174**	**128**	**192**	**171**	**43**	**9**	**7**	**1,791**	**183**	**638**	**1,463**	**25**	**74**	**-0.1**
AK	34	2	32	2	0	0	0	0	0	0	32	0	0	0	0	325.0
AL	94	3	91	2	1	0	0	0	0	1	3	19	67	0	1[f]	16.1
AR	91	685	1	0	3	2	0	0	76	1	8	0	0	0	0	-26.0
AZ	45	045	0	0	0	0	0	0	10	5	30	0	0	0	0	-46.4
CA	402	8	394	3	1	2	2	0	0	256	8	129	1	0	0	1.8
CO	28	0	28	0	0	0	0	0	0	1	0	27	0	0	0	-15.2
CT	8	0	8	0	0	0	0	0	0	0	0	8	0	0	0	166.7
DC	13	2	11	1	1	0	0	0	0	0	0	0	11	0	0	-71.1
DE	61	2	59	0	2	0	0	0	0	7	4	8	36	4[a]	0	577.8
FL	184	14	170	0	14	0	0	0	0	1	8	32	127	0	2[g]	65.8
GA	292	13	279	7	6	0	0	0	0	24	9	6	237	0	3[h]	39.7
HI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
IA	175	74	101	15	16	36	5	1	1	96	0	5	0	0	0	-35.7
ID	11	0	11	0	0	0	0	0	0	0	0	11	0	0	0	10.0
IL	32	4	28	2	0	1	1	0	0	16	0	11	0	0	1[i]	-30.4
IN	36	0	36	0	0	0	0	0	0	26	2	8	0	0	0	80.0
KS	41	3	38	1	1	1	0	0	0	35	0	3	0	0	0	-2.4
KY	106	23	83	15	1	5	2	0	0	78	2	2	1	0	0	-22.6
LA	13	1	12	0	1	0	0	0	0	8	0	4	0	0	0	0.0
MA	3	0	3	0	0	0	0	0	0	0	0	3	0	0	0	-40.0
MD	338	16	322	0	13	2	0	1	0	19	21	21	255	5[b]	1[j]	-24.9
ME	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	-66.7
MI	35	4	31	2	2	0	0	0	0	8	2	21	0	0	0	25.0
MN	142	42	100	7	6	27	2	0	0	92	1	7	0	0	0	-44.3
MO	36	6	30	3	2	1	0	0	0	18	0	12	0	0	0	-39.0
MS	9	0	9	0	0	0	0	0	0	0	0	9	0	0	0	0.0
MT	214	16	198	1	4	8	3	0	0	182	0	16	0	0	0	14.4
NC	8	0	8	0	0	0	0	0	0	4	1	3	0	0	0	0.0
ND	105	24	81	4	6	11	3	0	0	78	0	1	2	0	0	-18.6
NE	21	5	16	1	1	3	0	0	0	12	0	4	0	0	0	23.5

NH	4	1	3	1	0	0	0	0	0	0	0	3	0	0	0	0.0
NJ	15	0	15	0	0	0	0	0	0	0	0	15	0	0	0	-16.7
NM	15	4	11	0	2	0	2	0	0	6	1	4	0	0	0	400.0
NV	20	0	20	0	0	0	0	0	0	0	0	20	0	0	0	33.3
NY	40	1	39	0	0	1	0	0	0	0	1	38	0	0	0	-29.8
OH	6	0	6	0	0	0	0	0	0	0	0	6	0	0	0	-60.0
OK	38	6	32	2	0	3	1	0	0	31	0	0	1	0	0	8.6
OR	6	0	6	0	0	0	0	0	0	0	0	6	0	0	0	20.0
PA	543	48	495	3	21	16	8	0	0	73	18	11	380	12[c]	1[j]	67.6
PR	73	21	52	9	9	3	0	0	0	0	0	0	0	0	52[k]	4.3
RI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-100.0
SC	127	26	101	5	20	0	0	0	1	10	11	9	67	2[d]	2[l]	115.3
SD	137	40	97	5	10	22	1	1	1	92	1	3	0	0	1[m]	-39.9
TN	111	9	102	8	0	1	0	0	0	87	5	10	0	0	0	14.4
TX	434	78	356	21	30	14	9	4	0	266	20	57	4	0	9[n]	0.5
UT	10	0	10	0	0	0	0	0	0	0	0	10	0	0	0	42.9
VA	366	19	347	1	13	2	1	2	0	89	24	11	220	2[e]	1[f]	1.1
VT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	00.0
WA	4	0	4	0	0	0	0	0	0	0	0	4	0	0	0	-60.0
WI	55	14	41	4	3	6	1	0	0	38	0	3	0	0	0	14.6
WV	103	8	95	1	2	1	0	0	4	31	3	7	54	0	0	30.4
WY	39	6	33	1	3	2	0	0	0	20	0	13	0	0	0	-45.8
Percent‖	100	11.6	88.4	2.7	4.1	3.6	0.9	0.2	0.2	37.9	3.9	13.5	31.0	0.5	1.6	
Total 1987¶	4,729**	559	4,169	170	166	174	39	8	2	2,033	119	629	1,311	12	65	
% Chg§	-0.1	-1.6	+0.1	-24.7	+15.7	-1.7	+10.3	+12.5	+250.0	-11.9	+53.8	+1.4	+11.6	+108.3	+13.9	

*Rodents and lagomorphs include: (a) 4 groundhogs; (b) 5 groundhogs; (c) 11 groundhogs, 1 rabbit; (d) 1 squirrel, 1 rat; (e) 2 groundhogs.
†Other wild includes: (f) 1 bobcat; (g) 2 otter, 1 bobcat; (h) 3 bobcats; (i) 1 coyote; (j) 1 deer; (k) 52 mongooses; (l) 2 bobcats; (m) 1 badger; (n) 6 coyotes, 1 deer, 1 ringtail, 1 bobcat.
§Percent change from 1987.
‖Percentage of all rabid animals in 1988.
¶1987 total by species.
**Total includes one human case.

FIGURE 1. Cases of rabies in animals, by year, United States, 1955-1988

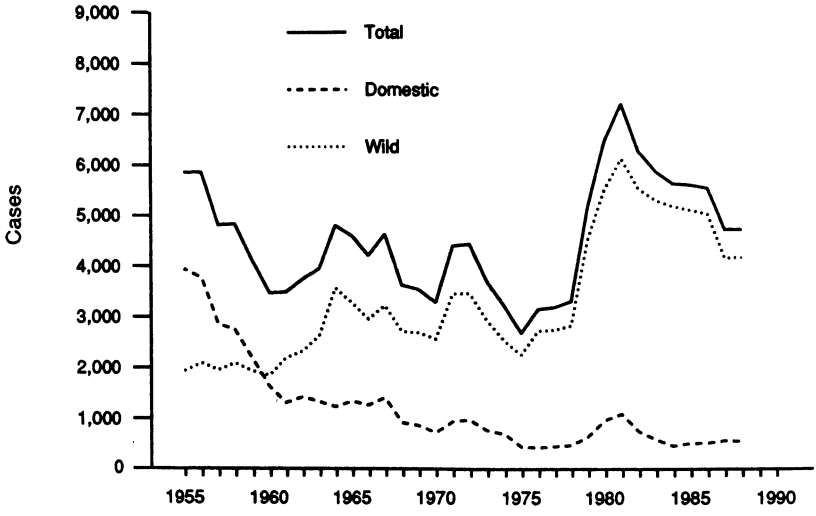


FIGURE 2. Cases of rabies in humans, by year and exposure category, United States*, 1950-1988

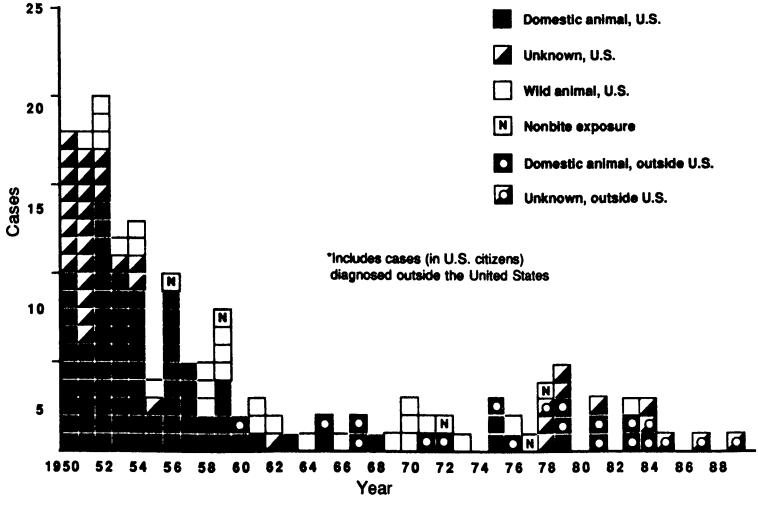


FIGURE 3. Cases of rabies in wild animals, by year, United States, 1955-1988

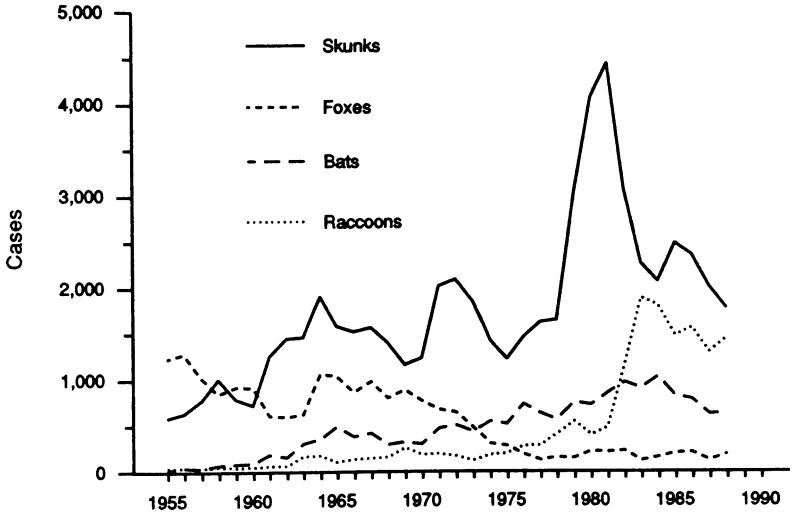


FIGURE 4. Cases of rabies in domestic animals, by year, United States, 1955-1988

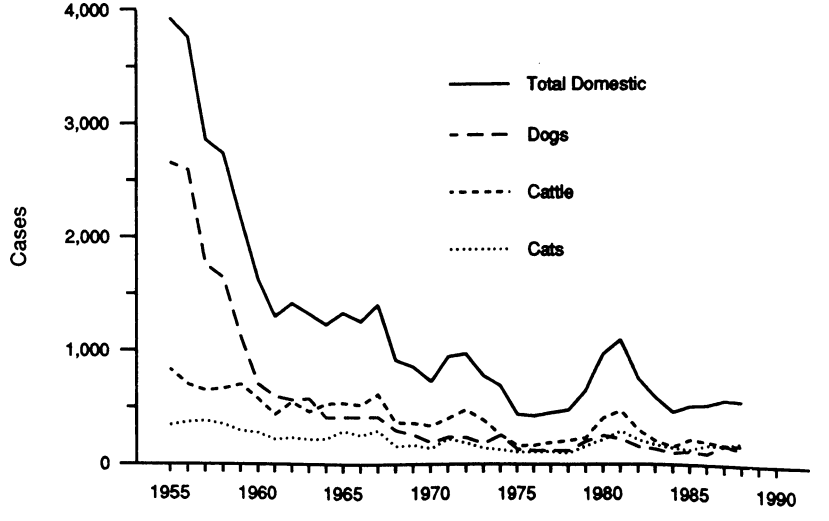


FIGURE 5. Distribution of five antigenically distinct rabies virus strains and the predominant wildlife species affected, contiguous United States, 1988

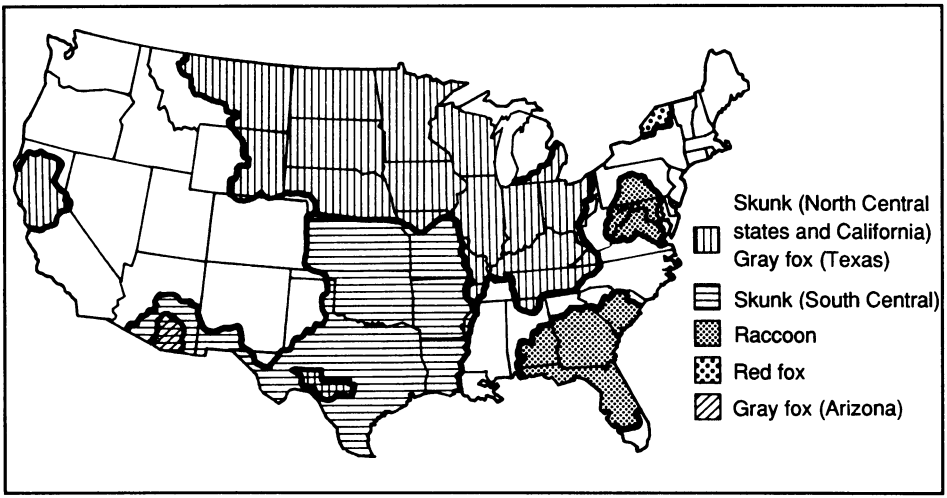


FIGURE 6. Cases of rabies in animals, by county, 1988

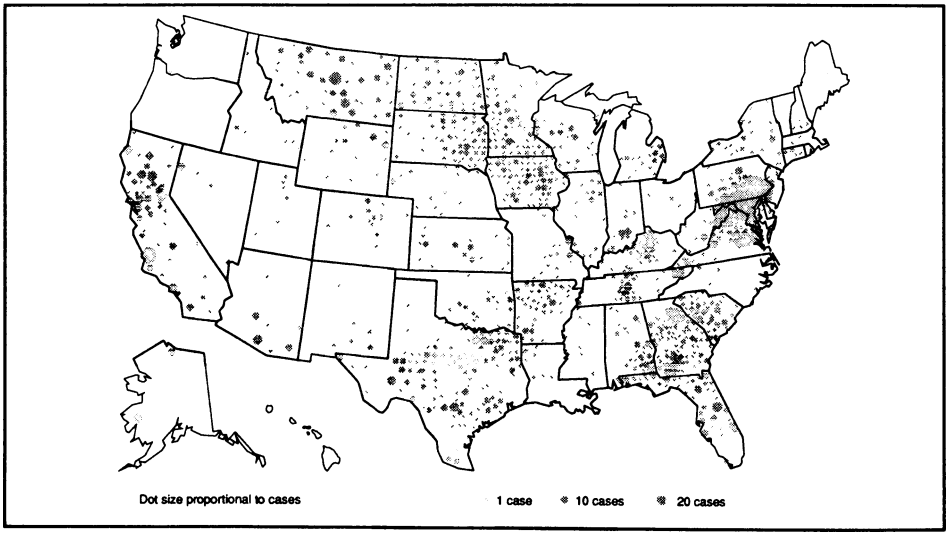


FIGURE 7. Distribution of rabies cases in animals, by geographic divisions, United States and U.S. Territories, 1988

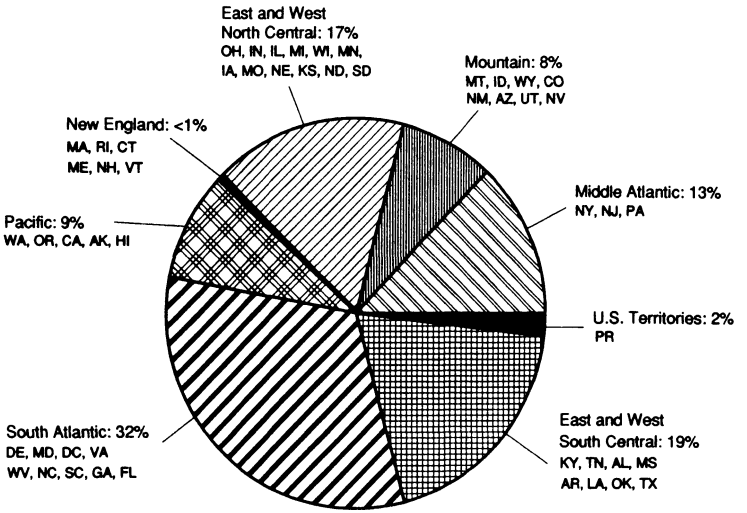


FIGURE 8. Distribution of rabies cases in animals, United States, 1988

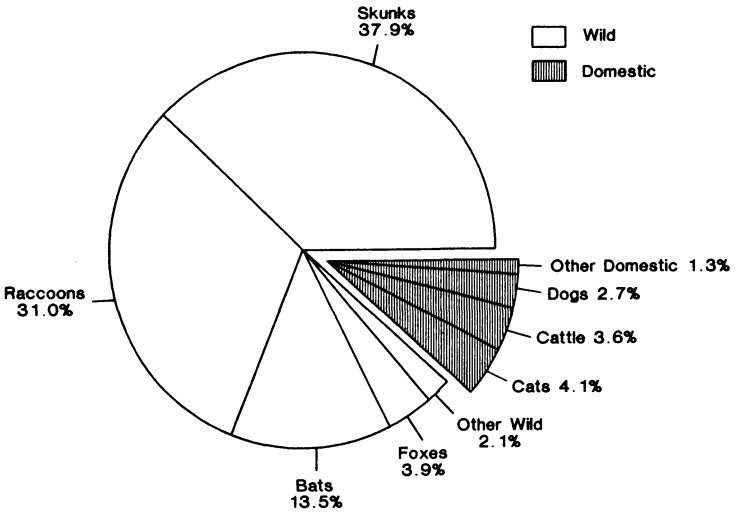


FIGURE 9. Cases of rabies in wild animals, by month, United States, 1988

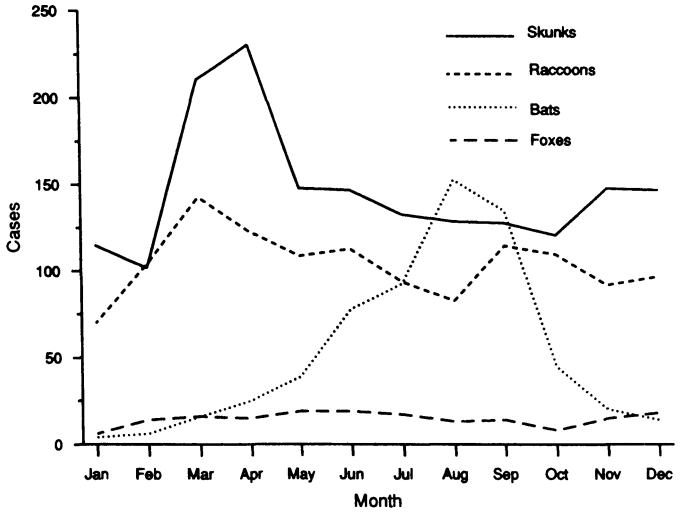


FIGURE 10. Cases of rabies in domestic animals, by month, United States, 1988

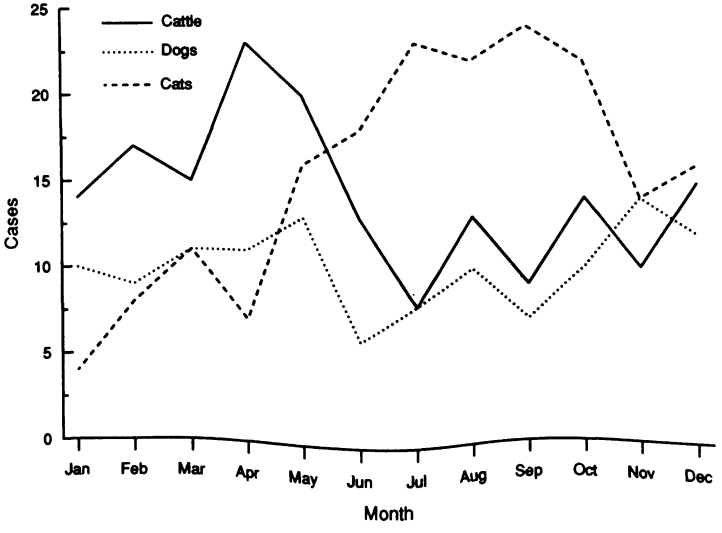


FIGURE 11. Cases of rabies in skunks, by county, 1988

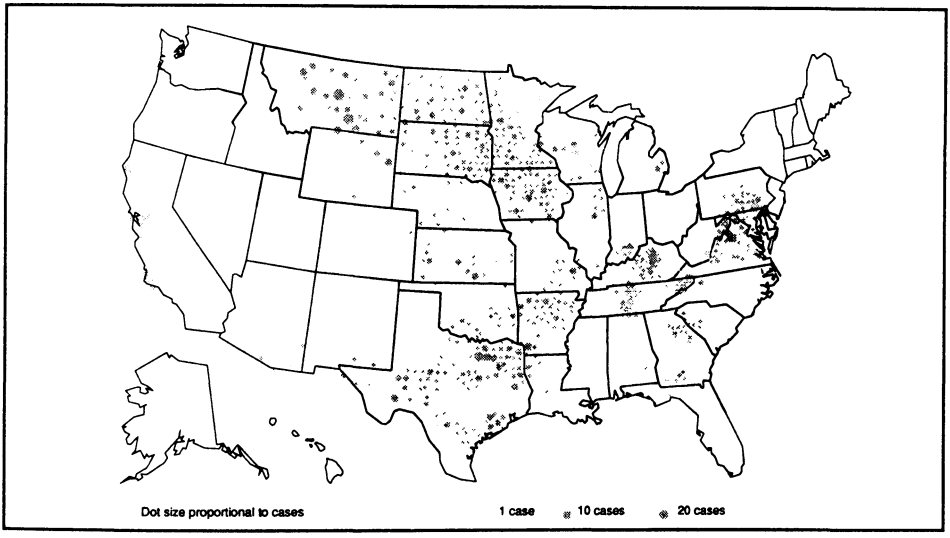


FIGURE 12. Cases of rabies in raccoons, by county, 1988

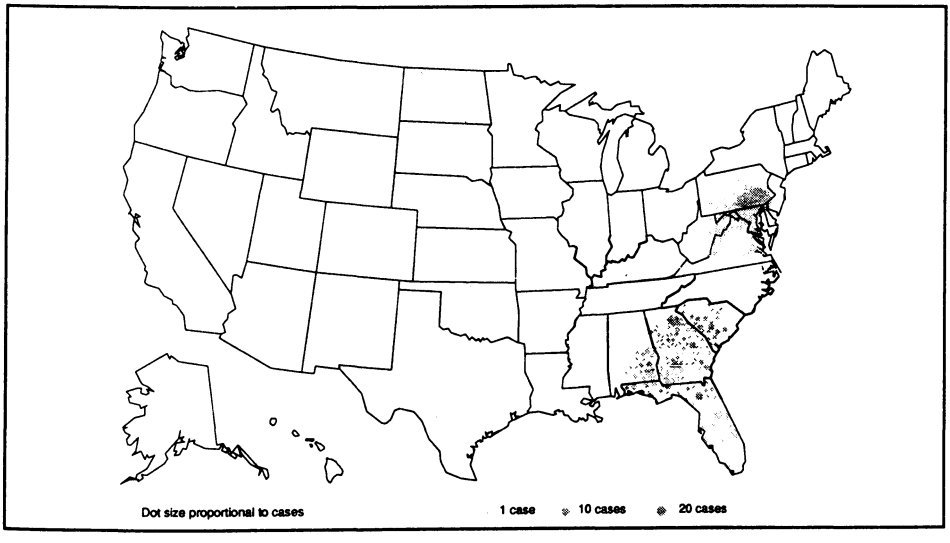


FIGURE 13. Changes in cases of rabies in raccoons, by county, 1987-1988

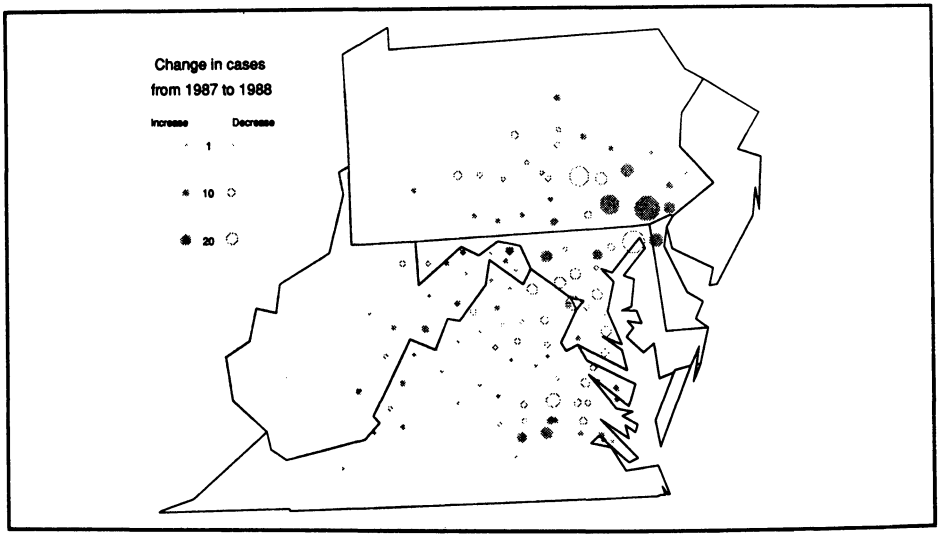


FIGURE 14. Cases of rabies in bats, by county, 1988

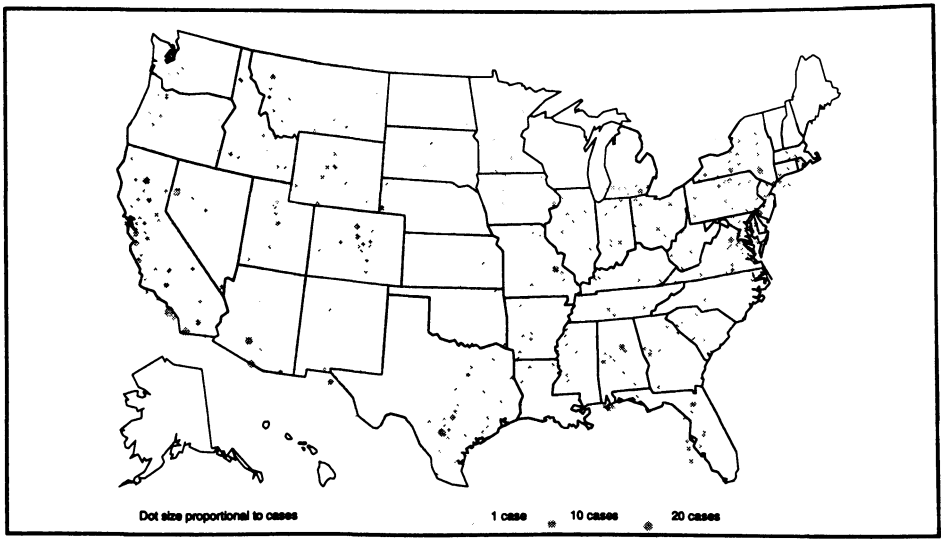


FIGURE 15. Cases of rabies in foxes, by county, 1988

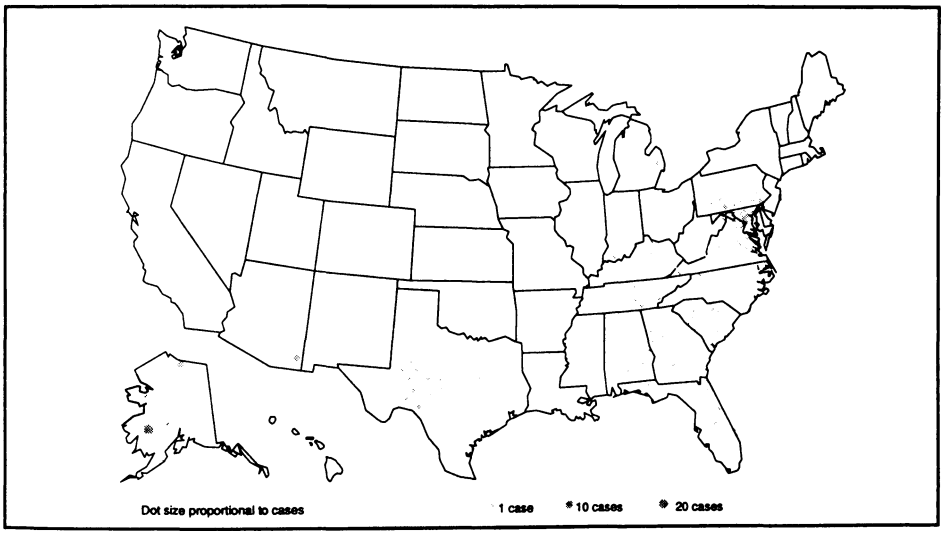


FIGURE 16. Cases of rabies in cats, by county, 1988

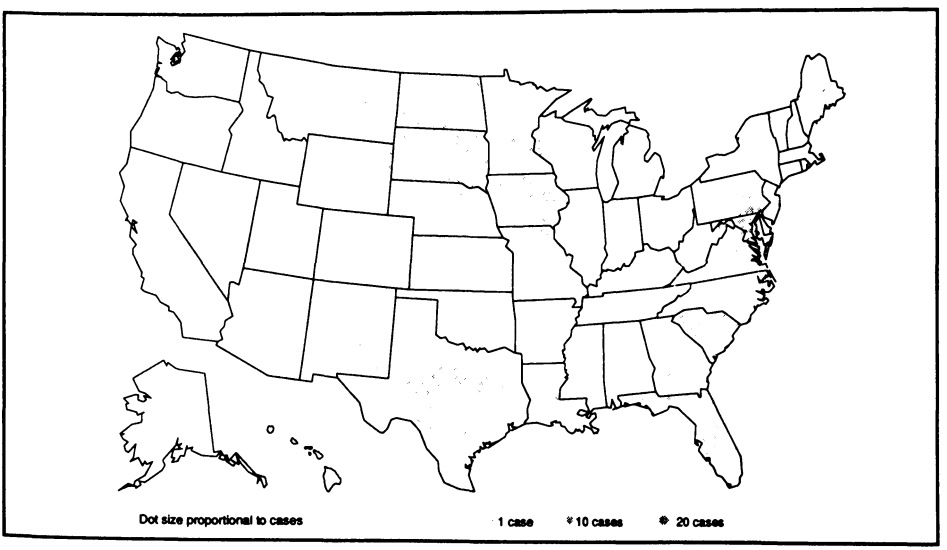


FIGURE 17. Cases of rabies in cattle, by county, 1988

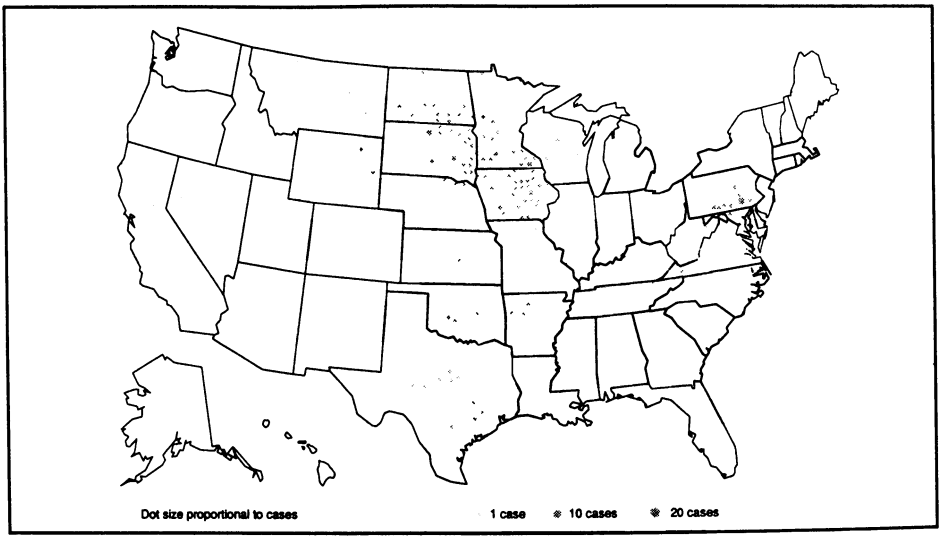


FIGURE 18. Cases of rabies in dogs, by county, 1988

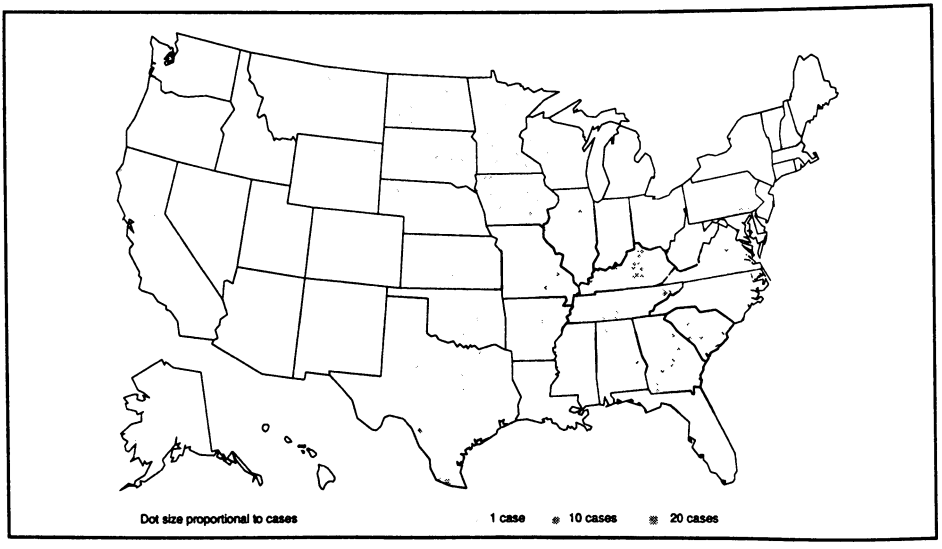
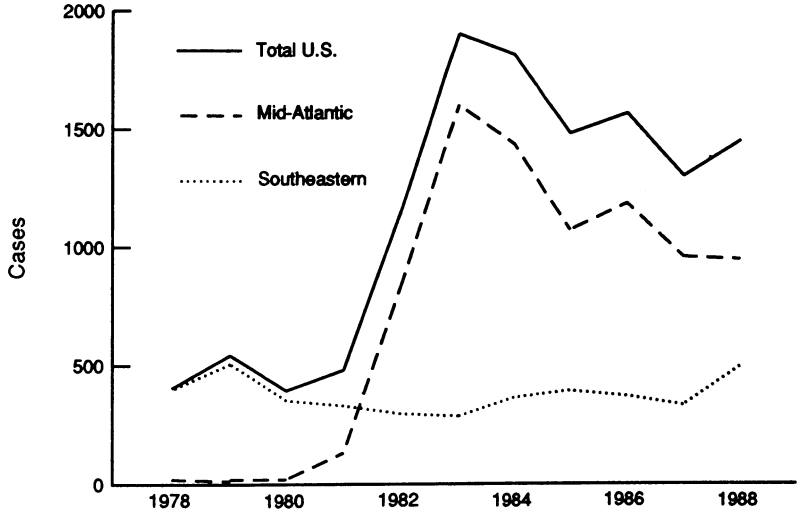


FIGURE 19, Cases of rabies in raccoons from the mid-Atlantic and southeastern epizootics, 1978-1988



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Guam	Vacant
Commonwealth of the Northern Mariana Islands	Vacant
Virgin Islands	Vacant
	Vacant

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State and Territorial Epidemiologists and State Laboratory Directors are gratefully acknowledged for their contributions to this report. The persons listed below were in the positions shown as of July 1989.

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