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CANINE AND GRAY FOX RABIES EPIZOOTICS IN TEXAS

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Abstract: In 1994, 2 ongoing rabies epizootics were declared a state health emergency: canine rabies in South Texas and gray fox (*Urocyon cinereoargenteus*) rabies in West-Central Texas. Prior to 1988, rabid coyotes (*Canis latrans*) were infrequently reported in Texas. In 1988, Starr and Hidalgo counties, located in extreme South Texas, experienced an epizootic of canine rabies resulting in 11 laboratory-confirmed cases of canine rabies in domestic dogs (*Canis familiaris*) and 6 cases in coyotes. By 1991, the epizootic had expanded approximately 160 km north of the United States (US)-Mexico border and included 10 counties. During the next 3 years, 8 additional counties became involved in the epizootic as it continued to move northward. During the 7-year-period, there were 531 laboratory-confirmed cases of canine rabies in 18 counties, and the epizootic was 255 km north of the US-Mexico border at its furthest extent. Gray fox rabies, which was endemic in West-Central Texas, also became epizootic in 1988. It began in Sutton County and rapidly expanded to include 6 additional counties by the end of the year with 23 laboratory-confirmed cases of gray fox rabies. From 1989 to 1994, a range of 1 to 13 new counties per year had recorded confirmed gray fox rabies cases. It had spread approximately 130 km northward and 225 km eastward from the index case. By the end of 1994, the epizootic included 35 counties in West-Central Texas with 524 laboratory-confirmed cases of gray fox rabies. Antigenic and genetic analysis revealed the ecotype primarily affecting domestic dogs and coyotes in South Texas to be urban Mexican dog and the rabies ecotype primarily affecting gray foxes in West-Central Texas to be Texas fox. The epizootics are approaching large metropolitan areas; an increase in vaccination levels of domestic animals would help provide a barrier between rabid wild animals and humans.

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Key words: canine, *Canis familiaris*, *Canis latrans*, coyote, dog, epizootic, gray fox, rabies, Texas, *Urocyon cinereoargenteus*.

Rabies, a fatal viral disease that is transmitted from animals to humans, has become a serious problem in Texas. There are 2 rabies epizootics (epidemics in animals) that started in 1988 and have continued through 1994: canine rabies in South Texas and gray fox (*Urocyon cinereoargenteus*) rabies in West-Central Texas. In July 1994, the ongoing rabies epizootics were declared a state health emergency. This paper documents past occurrence and the recent spread of these 2 rabies epizootics.

Between 1961 and 1988, only 25 rabid coyotes (*Canis latrans*) were reported in Texas. In 1988, however, a viral ecotype that had been confined to urban dogs became established in the coyote population along the United States (US)-Mexico border. This canine strain of rabies is readily transmitted from coyotes to domestic dogs and, subsequently, between domestic dogs (Clark et al. 1994). The transmission capability of the virus is pertinent from a public health standpoint because a rabies outbreak involving domestic animals greatly increases the risk for human exposure, as opposed to an outbreak that is maintained strictly in a wild animal population.

Gray fox rabies is defined as that strain of rabies virus that is adapted to gray foxes and is transmitted from fox to fox; it does not include spillover to foxes from other species, such as when a rabid striped skunk (*Mephitis mephitis*) infects a fox, but does include any animal that is infected by the strain

of rabies peculiar to gray foxes. In 1946, an epizootic of fox rabies began in Sabine County, located in East Texas, and spread in a southwesterly direction through 1955, with 1,095 recorded cases. During the 1960's, fox rabies disappeared from the eastern portion of the state and localized in West Texas where, in the 1970's and 1980's, it became enzootic (present at low levels in animals in an area or population at all times) (G.M. Moore, Tex. Dep. of Health, unpubl. data).

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STUDY AREA AND METHODS

Case Report Form

Each case of animal rabies was investigated by TDH Zoonosis Control Division personnel. A standardized form, the Zoonotic Incident Case Report, was used statewide. The form included date, location, and description of the incident that caused rabies to be suspected and the animal's medical history (if known), vaccination status, and any human or domestic animal contacts. The policy of the TDH is to test only animals that have potentially exposed a human or a domestic animal;

active surveillance is not routinely conducted because an adequate sampling is provided under this policy.

Laboratory Procedures

Brain tissue specimens were tested for rabies antigen by immunofluorescence microscopy at the TDH Laboratory in Austin. Positive specimens were further tested with a panel of monoclonal antibody (MAB), each directed against a specific antigenic site on the rabies virus nucleocapsid and were evaluated by immunofluorescence microscopy (Smith et al. 1986). Differences in nucleotide sequences were examined by polymerase chain reaction (PCR) techniques (Smith et al. 1984, Smith et al. 1991).

The MAB and PCR procedures identified 3 ecotypes common in terrestrial animals in Texas, which were designated as Texas skunk (TS), Texas fox (TF), and urban Mexican dog (UMD). Although the TS ecotype was distinguished using only MAB techniques, the TF and UMD ecotypes could not be differentiated by MAB. PCR techniques were required on specimens that were classified, according to MAB results, as Texas fox/Mexican dog (TFMD) to determine if they were the TF or UMD ecotype. The TF ecotype was found in southwest Texas in gray foxes and animals infected by contact with gray foxes, and the UMD ecotype was found along the US-Mexico border in dogs, coyotes, and animals infected by dogs and coyotes (Clark et al. 1994).

RESULTS AND DISCUSSION

Canine Rabies Epizootic

The index case for the canine rabies epizootic in South Texas occurred on 3 September 1988 in Starr County, which is located on the US-Mexico border. A coyote that had fought with 2 vaccinated dogs was submitted for rabies testing and determined rabid by immunofluorescence microscopy. This was the first rabid terrestrial animal reported in the area in 18 years. Four weeks later, another rabid coyote was detected approximately 16 km north of the index case; it was tested after it attacked 3 unvaccinated dogs. Two months after the index case, a rabid coyote was reported near Rio Grande City (RGC), which is located on the US-Mexico border in south-central Starr County; this coyote also fought with 3 unvaccinated dogs prior to being tested. Three weeks later, the first rabid dogs in Starr County were recorded, both from the RGC area. By the end of 1988, there were 6 rabid coyotes and 2 rabid dogs reported from Starr County. Hidalgo County, adjacent to Starr County, became involved in the epizootic on 15 November 1988 when a 9-week-old dog was confirmed positive for rabies. This incident occurred 55 km southeast of the index case and involved a dog that had been mauled 12 days earlier by a wild animal that was suspected to be a coyote. From mid-November through December 1988, there were 9 rabid dogs recorded in Hidalgo County.

During the first 6 months of 1989, only 1 rabid coyote was reported from Starr County. However, from July through December, 15 rabid dogs (all from the RGC area), 4 rabid coyotes, and 1 rabid raccoon (*Procyon lotor*) were de-

tected in this county. Hidalgo County continued to have recorded cases of rabid dogs; 19 dogs, 1 coyote, 1 cat, and 1 raccoon were confirmed rabid during 1989. In 1990, the localized RGC epizootic continued and involved 15 dogs, 3 cats, and 3 coyotes. Two of the dogs had a known attack by a coyote within a month prior to developing clinical signs. In Roma, 20 km upriver from RGC, 16 rabid dogs were reported. After state health department officials and local health professionals initiated aggressive rabies control measures, Hidalgo County had no reported rabies cases during 1990.

In 1991, the canine rabies epizootic expanded approximately 160 km north of the U.S.-Mexico border to include the following 10 counties: Brooks, Duval, Hidalgo, Jim Hogg, Jim Wells, Kenedy, Kleberg, Nueces, Starr, and Zapata. By the end of 1991, there were 25 dogs, 42 coyotes, and a raccoon, cat, skunk, and cow confirmed rabid. A human death attributable to canine rabies also occurred in 1991. The patient, a 55-year-old Starr County woman, had no history of exposure, but laboratory tests determined that she was infected with the canine strain of rabies virus.

Webb and Willacy counties became active in 1992; there were 41 rabid dogs, 70 rabid coyotes, and a rabid bobcat (*Felis rufus*), cat, cow, goat, horse, and raccoon reported from the 12-county area. Cameron County, located in the southernmost tip of Texas, was included in the epizootic in May 1993 when a raccoon with the canine strain of rabies was reported. La Salle County became the northernmost extension of the epizootic in November 1993. During 1993, positive rabies cases in the 14 South Texas counties included 42 dogs, 69 coyotes, 7 cats, 4 raccoons, 1 cow, and 1 bobcat.

The northward movement continued in 1994 with the addition of Live Oak and McMullen Counties in March, and Frio and Dimmit Counties in September, extending the epizootic approximately 255 km north of the U.S.-Mexico border (Fig. 1). Confirmed rabies cases for 1994 included 32 dogs, 74 coyotes, 7 raccoons, 4 cows, 2 horses, 2 cats, and 1 bobcat. Another human death attributable to canine rabies occurred in South Texas in 1994. The 14-year-old Hidalgo County boy had no history of exposure, but the rabies virus was confirmed to be the UMD strain (J.S. Smith, CDC, pers. commun.). This second case of human rabies with the Texas canine strain of rabies virus emphasizes the fact that the canine rabies epizootic is particularly dangerous to humans because of increased exposure rates from the associated domestic dog population.

From 1989 through 1990, the number of rabid dogs reported in South Texas was greater than the number of rabid coyotes. In 1991, more rabid coyotes than rabid dogs were recorded per year; this trend has remained consistent through 1994. The shift in predominant rabid species may be attributed to increased vaccination levels in dogs initiated by increased public awareness and low-cost vaccination clinics. In Starr County, clinics have been sponsored by the TDH, the U.S. Army, Rhone Merieux, Inc., the Texas National Guard, and a local veterinary practitioner. Consequently, vaccination levels in Starr County dogs that were exposed to a known rabid animal increased from 18.2% in 1988 to 50% in 1994.

Gray Fox Rabies Epizootic

Prior to 1988, gray fox rabies was enzootic in West Texas with case levels ranging from 3 to 16 per year from 1982 through 1987. The highest number of cases during this 6 year period occurred in Kimble (7 cases) and Kerr (6 cases) Counties. In 1988, the number of animals confirmed infected with the TFMD strain of rabies escalated to 23 and involved 12 gray foxes, 6 cats, 1 goat, 1 sheep, 1 bobcat, 1 cow, and 1 raccoon. The first case occurred on 1 January 1988 near the city of Sonora in Sutton County, which is adjacent to the west side of Kimble County. Surrounding counties that subsequently became involved in the outbreak included, in chronological order, Val Verde, Menard, Crockett, Tom Green, Uvalde, and Kinney. Rabies positive cases were reduced in number in 1989 to 11 foxes and 1 cat; 2 new counties, Pecos and Terrell, were included in the epizootic.

During 1990, the epizootic was centralized in Val Verde County, which is adjacent to the south side of Sutton County, with 19 cases of gray fox rabies. At this time, Edwards was added to the list of involved counties. Animals confirmed infected with gray fox rabies during 1990 included 23 foxes, 3 goats, 3 bobcats, 3 cows, 2 horses, 2 dogs, and 2 raccoons. In 1991, the epizootic expanded in a southeast direction to include Bandera, Kerr, Kimble, Medina, Real, and Schleicher Counties. There were 68 recorded rabies cases in the 12 counties; Uvalde County was the most active with 21 cases. A wide variety of species were laboratory-confirmed positive for the TFMD strain of rabies, including 34 foxes, 10 raccoons, 7 cats, 5 cows, 4 goats, 4 coyotes, 2 dogs, 1 bobcat, and 1 porcupine (*Erethizon dorsatum*).

In 1992, Irion and McCulloch Counties were added to the list of counties afflicted with gray fox rabies. Kimble

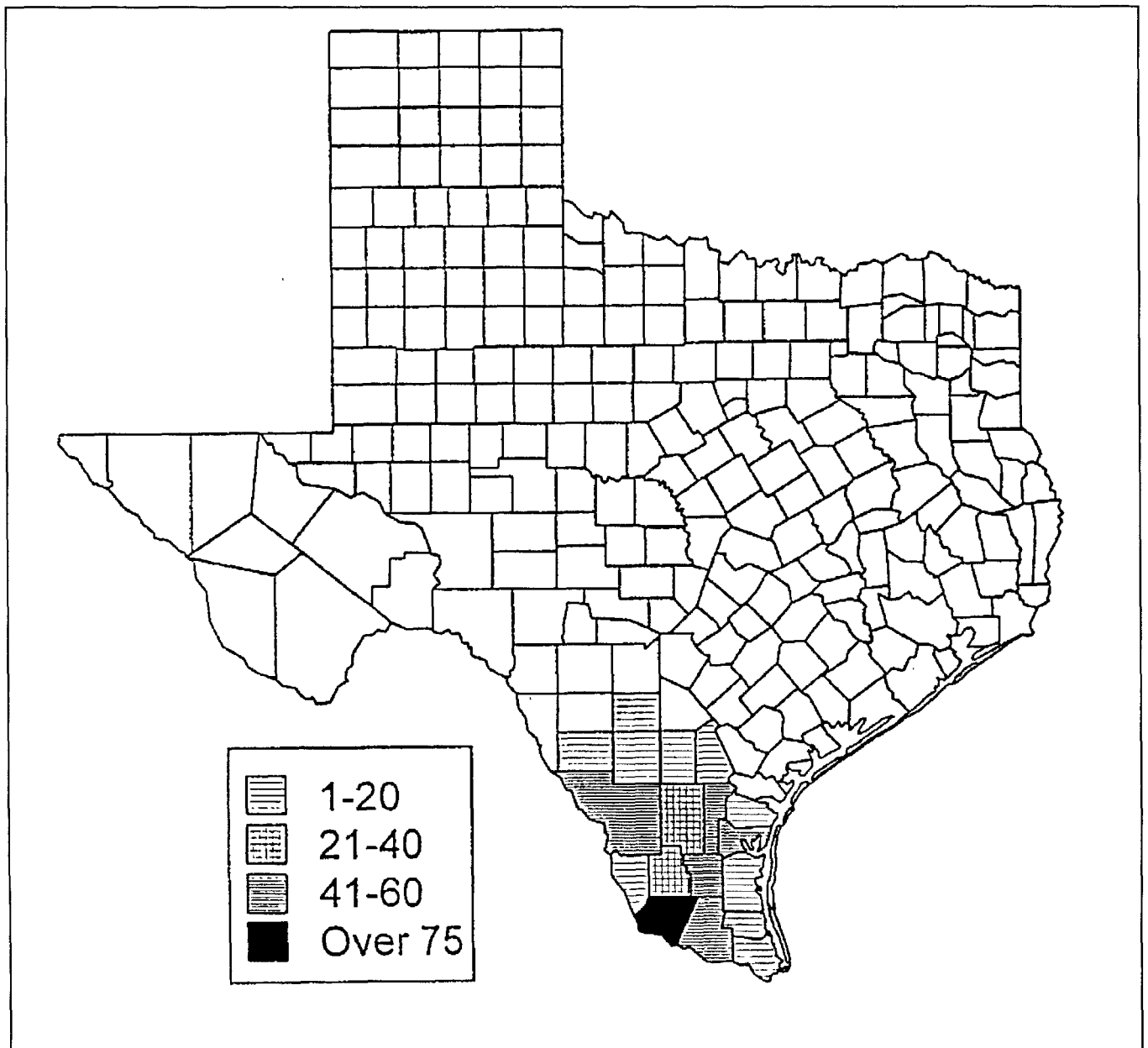


Fig. 1. Incidence of canine rabies in South Texas, 1988-1994.

County was the most active with 14 of the 60 reported cases. Gray fox rabies cases during this time included 28 foxes, 8 bobcats, 6 cats, 5 dogs, 4 goats, 4 raccoons, 2 sheep, 1 cow, 1 llama, and 1 ringtail (*Bassariscus astutus*). Concho, Kendall, Presidio, and Upton counties became involved in 1993; rabid species in the epizootic consisted of 35 foxes, 10 raccoons, 5 dogs, 3 cats, 2 bobcats, 2 coyotes, 1 cow, and 1 goat.

During 1994, 13 new counties recorded gray fox rabies cases, including Bexar, Brewster, Brown, Coke, Coleman, Crane, Lampasas, Mason, Mitchell, Reagan, Runnels, San Saba, and Sterling. Concho, Edwards, Irion, Kerr, Kimble, McCulloch, Medina, Menard, Sutton, Tom Green, Upton, Uvalde, and Val Verde counties continued to be involved. The epizootic had rapidly expanded from the index case in Sutton County northward approximately 130 km to Runnels, Coleman,

and Brown Counties, and eastward approximately 225 km to Lampasas County (Fig. 2). McCulloch County, which had 8 cases of gray fox rabies during the last 2 months of 1993, had an impressive upsurge in 1994 with 67 cases. Of these cases, 55 were during the first 3 months of the year. By March, the cases of gray fox rabies in Tom Green County, which is adjacent to the west side of Concho County, began to greatly escalate resulting in 80 cases for the year. There were 264 cases of gray fox rabies in a 26 county area during 1994, including 140 foxes, 52 raccoons, 20 cats, 16 dogs, 12 cows, 9 goats, 5 bobcats, 3 coyotes, 2 horses, 2 ringtails, 2 sheep, and 1 rabbit.

During the 7-year period, there were 283 foxes, 79 raccoons, 43 cats, 30 dogs, 23 cows, 22 goats, 20 bobcats, 9 coyotes, 5 sheep, 4 horses, 3 ringtails, 1 porcupine, 1 llama, and 1 rabbit confirmed positive for gray fox rabies. A charac-

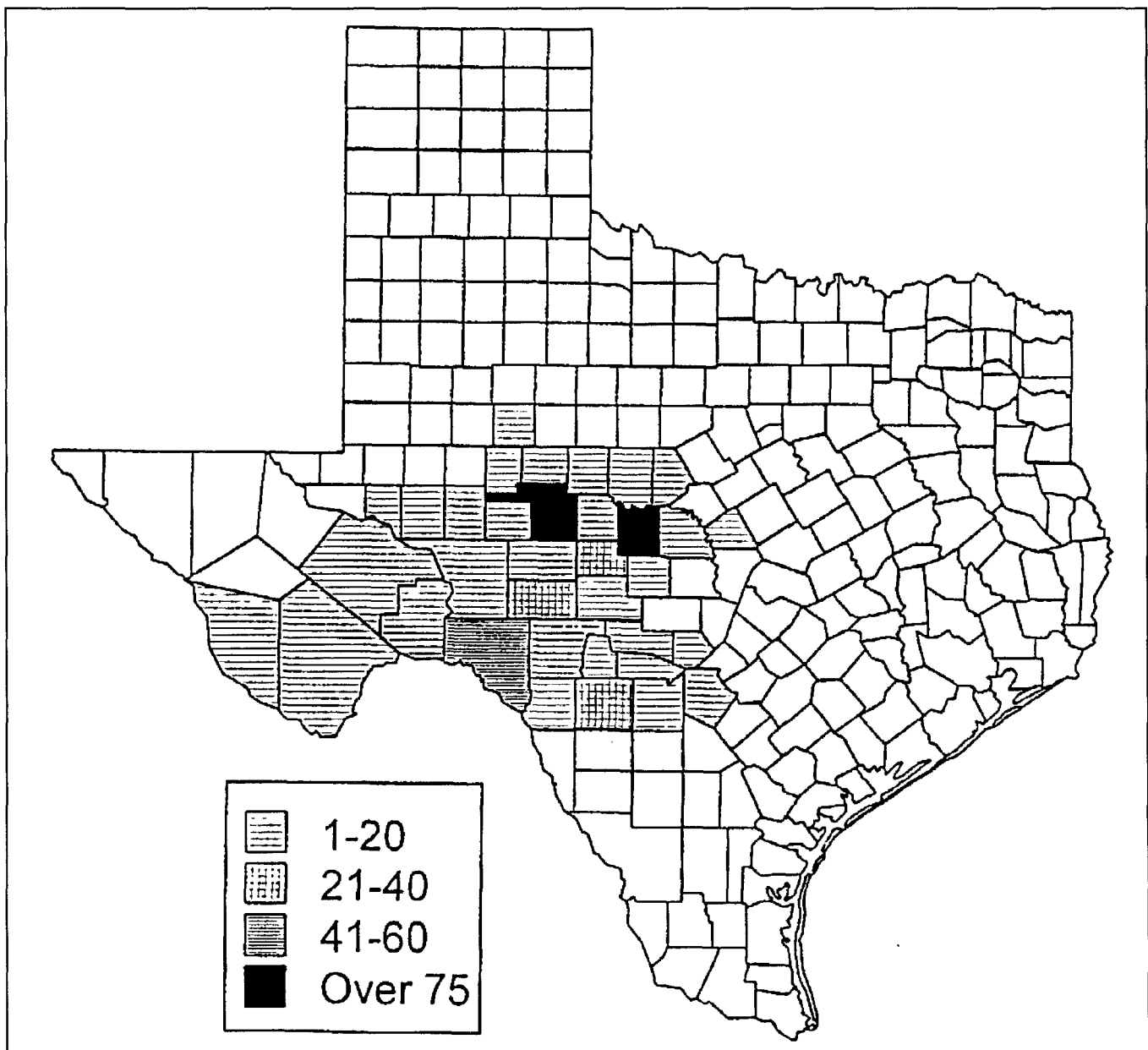


Fig. 2. Incidence of gray fox rabies in West-Central Texas, 1988-1994.

teristic of gray fox rabies that became evident during the epizootic was that it readily transmitted to raccoons and to livestock, especially cows and goats. This may be attributable to greater inherent susceptibility, habitat relationships with other species, and behavioral traits that increase exposure.

MANAGEMENT IMPLICATIONS

The northernmost identified case of canine rabies was approximately 45 miles southwest of San Antonio. Based on the average spread rate of the epizootic since 1988, it will reach this large metropolitan area by 1995 if it is not controlled. As in many major cities in the United States, San Antonio has an urban coyote population; this, combined with the estimated 75% unvaccinated dog population in the area, forms an explosive combination for the canine rabies epizootic.

The reestablishment of gray fox rabies as an epizootic can be explained by the fact that rabies is a disease of overpopulation. An increase in the number of gray foxes has resulted from the loss of the market for pelts. Gray foxes inhabit approximately 230 of the 254 counties in Texas (they are not commonly found in the northernmost 24 counties) and give birth to 3 to 6 pups per litter each year. Therefore, it is expected that the gray fox epizootic will continue to move north and east toward metropolitan areas, such as San Antonio, Austin, Abilene, and Dallas.

An increased vaccination level in pets and livestock is very important for rabies prevention. Historically, human rabies cases declined when canine rabies cases decreased because of increased vaccination rates, even though rabies cases in wild animals were elevated during the same time period. In the early 1950's, the number of U.S. rabies cases in dogs and humans peaked. In the mid-1950's, dog and human rabies cases declined with the advent of highly effective rabies vaccine for dogs and maintained this lower level through the early 1990's.

However, U.S. rabies cases in wild animals peaked in the early 1960's, the late 1970's and early 1980's, and again in the early 1990's. People do not commonly encounter rabid wild animals, but rabid pets and livestock can bring the disease into the home or ranch area. Rabid domestic animals are 5 times more likely to come into contact with a human than are rabid wildlife (Clark 1988). Vaccinated domestic animals can break the rabies transmission cycle by creating a buffer zone between rabid wild animals and humans. It is also beneficial to decrease the number of stray animals and increase knowledge of bite avoidance techniques. To ensure these actions, rabies education for government employees, animal control officers, and the general public is essential.

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