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Authors: LORD, REXFORD D., DELPIETRO, HORACIO, FUENZAUDA, EDUARDO, DE DIAZ, ANA MARIA OVIEDO, and LAZARO, LUIS

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PRESENCE OF RABIES NEUTRALIZING ANTIBODIES IN WILD CARNIVORES FOLLOWING AN OUTBREAK OF BOVINE RABIES

REXFORD D. LORD,[1] HORACIO DELPIETRO,[2] EDUARDO FUENZALIDA,[1]

ANA MARIA OVIEDO DE DIAZ[1] and LUIS LAZARO[1]

Abstract: In an outbreak of bovine rabies in Argentina, a study was made of vampire bats (*Desmodus rotundus*) and wild carnivores. Rabies antibody rates of high prevalence were found in the bats, foxes (*Dusicyon gymnocercus*) and skunks (*Conepatus chinga*). The outbreak was part of an extensive continuing epizootic of vampire transmitted bovine rabies which may have also involved other vectors in the area of this study. Consumption of dead and dying bats by the carnivores is the suggested means of passage of rabies virus from vampire bats to foxes and skunks. Given optimum conditions it is conceivable that some outbreaks in carnivores may begin in this way.

The role of vampire bats as vectors of bovine rabies is well known.[1,9] Normally infection of livestock occurs during the course of feeding by an infected vampire bat.[3] Thus, those livestock which serve most frequently as the source of blood meals for vampire bats are likewise the principal victims when the bats become infected with rabies. All bovine rabies is not attributable to the bite of infected vampire bats, since the disease also occurs in areas where there are no vampires. In these areas, bovine rabies is spread by skunks, foxes, dogs, etc., and since these animals also occur in areas where there are vampire bats, they may sometimes be responsible for bovine rabies in the vampire areas as well.

During an outbreak of bovine rabies which began in 1970 on Apipé Island in the Paraná River, in the Province of Corrientes in northeastern Argentina, there was circumstantial evidence that not all cattle dying of rabies were bitten by vampire bats. The area is comprised of extensive open rolling grassland. Vampire bat roosting habitat is confined to narrow strips of woods lining the banks of streams. On the "Estancia Maria Concepcion", about 50 km northwest of Santo Tomé, approximately 50 cattle and three horses died of rabies. The diagnoses were confirmed by laboratory examination of brain tissue samples. Some cattle died at distances up to 10 km from the Aguapey river, the only habitat available to vampire bats in the region. Many of these cattle, due to the division of the pastures, could not approach nearer than 4 or 5 km to the river. Since there were many cattle pastured beside the river, it did not seem likely that the bats would fly so far to feed when there was an abundant source of blood nearby. Although foxes are abundant along the river and skunks abound everywhere, no rabid foxes, skunks or dogs were reported.

This paper reports the results of a study of the vampire bats, wild carnivores and cattle of this outbreak.

[1] Pan American Health Organization, Pan American Zoonoses Center, Casilla 23, Ramos Mejia, Province of Buenos Aires, Argentina.

[2] Servicio de Luchas Sanitarias (SELSA). Ministerio de Agricultura y Ganaderia, Beunos Aires, Argentina.

METHODS

In December, 1971, following the report and laboratory confirmation in August of bovine rabies on the "Estancia Maria Concepcion", 48 unvaccinated cattle were bled and their sera tested for neutralizing antibodies to rabies virus.

In January, 1972, 5 months after the outbreak, studies were made of the relative abundance of vampire bats along the river and in the pastures far from the river where cattle had died. Standardized lines of mist nets were placed in both localities. Captured bats were bled and killed. Brain, salivary gland, interscapular fat and saliva were tested for virus. Bat sera were tested for rabies neutralizing antibodies.

In April, 1972, 8 months after the outbreak, wild carnivores were captured along the river where vampire bats were previously found to be abundant. All mammals were bled, marked with an ear tag and released. Their sera also were tested for rabies neutralizing antibodies.

All virus isolation attempts were made by the mouse inoculation technique,[9] and brains of mice dying 5 days or longer after inoculation were studied by the rabies immunofluorescence test as described elsewhere.[7] The serum neutralization (SN) test followed standard procedures using 3 week old mice.[2]

RESULTS

Of the 48 unvaccinated cattle bled in December, 4 months following the outbreak of rabies, 16 (33%) had antibody to rabies virus when examined by the serum neutralization test. The serum titers were as follows: 1:2-1:5 (6 animals), 1:6-1:25 (4), 1:26-1:125 (2), greater than 1:125 (4). Similar results have been reported previously.[10]

Netting in a pasture 3 km from the river, where cattle had died of rabies, yielded no vampire bats. Along the bank of the river, however, 12 vampire bats were netted, seven (58%) of which had serum neutralizing antibody to rabies virus. End point titrations were not made, but five of the bat sera had titres of at least 1:5 and two bat sera titrated 1:6 or greater. No virus was isolated from the tissues of these 12 bats.

In April, trapping efforts (240 trap-nights) along the river where vampire bats were caught in January resulted in the capture of eight foxes, six opossums (*Didelphis albiventris*) and two skunks. In 300 trap-nights two *Calomys* spp., two *Oryzomys flavescens* and one *Cavia pamparum* were captured. Serum neutralization tests showed rabies antibody in the sera of four of the eight foxes. Both skunks were SN positive. Serum titers ranged about 1:5 in those samples available for titration. None of the opossums or rodents had antibody.

Of the four foxes with antibody, three were approximately 9 months old. Age determination was based on multiple factors such as tooth wear,[12] pelage,[8] and development of secondary sexual characteristics, e.g., mammary nipples. Both skunks were more than 1 year old.

Netting along the river in April, simultaneously with carnivore trapping, resulted in the capture of only four vampire bats in 20 net-nights. All four bats were SN negative. In May only 6 vampire bats were netted in 10 net-nights and all bats were also SN negative.

DISCUSSION

It appears that the carnivores on the "Estancia Maria Concepcion" were in some way sufficiently exposed to rabies virus to develop antibody and the timing of this exposure coincided with an outbreak of bovine rabies. The bovine rabies outbreak which was passing through the area was a continuation of a typical vampire bat epizootic.[5] However, an investigation of wild carnivores was initiated because some of the animals which died of rabies lived far from the habitat along the Aguapey River occupied by vampire bats.

The occurrence of rabies antibody in wild carnivores and vampire bats has been previously reported.[11,15]

Infection of skunks (*Mephitis mephitis*) by eating mice which died of rabies has been demonstrated[3] as has infection of foxes by bat bite.[4]

We do not suggest that the foxes and skunks with rabies antibody in this study were necessarily exposed through the bite of an infected vampire, but rather that these carnivores may have found and eaten vampire bats which were dead or dying of rabies. During the course of this study no other bat species were captured or noted in this area. Whether any of the wild carnivores actually developed rabies as a disease and subsequently bit livestock is not known. The proportion of positive antibody sera in our samples indicates that significant numbers of animals were exposed and it seems reasonable to assume that some may have developed the disease.

Whether passage of rabies virus from vampire bats or other bats to terrestrial carnivores develops into an epizootic in the carnivores is presumably dependent on the usual epizootiological factors, especially density of the host species. There may be some as yet to be demonstrated differences in strains of rabies virus, however evidence obtained in this study suggests that terrestrial carnivores may become exposed to rabies virus in some way during an epizootic in bats. Presumably, under optimum condition, passage of virus from bats to some carnivores could result in a rabies outbreak in the carnivores.

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