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Source: Journal of Wildlife Diseases, 33(2) : 242-245

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-33.2.242

Journal of Wildlife Diseases, 33(2), 1997, pp. 242–245

OCCURRENCE OF RABIES IN WOLVES OF ALASKA

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ABSTRACT: We describe a rabies epizootic in northwest Alaska (USA) during 1989 and 1990 which resulted in mortality to several different wolf (*Canis lupus*) packs. Four radio-collared wolves were confirmed to have rabies while evidence for seven others was strongly suggestive but not confirmed. The wolf population declined during the rabies epizootic; thus rabies may have been a significant limiting factor.

Key words: Rabies, wolf, *Canis lupus*, Alaska, epizootic, mortality, survival.

INTRODUCTION

Rabies has occurred sporadically in nearly all areas of the world where wolves (*Canis lupus*) occur (Cowan, 1949; Mech, 1970; Bacon, 1985). Mech (1970) suggested that rabies was one of the most important wolf diseases, but its role in limiting or regulating wolf populations was unknown. Besides Chapman's (1978) account of rabies eliminating one wolf pack in Alaska (USA), only accounts of mortality to individual wolves exist in the literature.

Rausch (1972) reported five cases of rabies among Alaskan wolves from 1949 to 1972. Chapman (1978) documented the occurrence of rabies within one wolf pack on the north slope of the Brooks Range, Alaska during 1977. He observed one wolf actively attacking other pack members at a rendezvous site. The attacking wolf was later diagnosed with rabies. At least seven of 10 pack members died. Rabies was verified for three of these wolves, but cause of death of the others could not be verified because of decomposed carcasses (Chapman, 1978). Alaskan wolves seldom die during summer (Peterson et al., 1984; Ballard et al., 1987). Therefore, rabies was the most likely cause of death for the other four wolves. At least five of the wolves died at two rendezvous sites, leading Chapman (1978) to propose that rabid wolves remained in familiar areas and were unlikely to transmit the disease to other wolf packs.

Davis et al. (1980) reported that wolf populations were relatively high in northwest Alaska during the early 1970s but declined after 1976. It was speculated that rabies could have been one of several factors which caused the decline. However, this conclusion was conjectural since only one diagnosis was confirmed (Ritter, 1981). In this study we report on a rabies epizootic within a northwest Alaska wolf population during 1989 and 1990, and discuss the importance of this disease as a wolf population mortality factor.

MATERIALS AND METHODS

Wolf demography and predation rates were studied in northwest Alaska during 1987 through mid-1992 (Ballard, 1993). The 12,000 km^2 study area was located approximately 200 km east of Kotzebue, Alaska (65°15′ to 67°30′N; 156°30′ to 160°00′W). Topography, vegetation, climate, and general ecology of the area are described by Ballard (1993).

Eighty-six wolves were captured by darting from a helicopter (Ballard et al., 1991) and radio-collared (Telonics, Inc., Mesa, Arizona, USA) between 1987 and 1991. Radio-collared wolves were located and observed at least once every 2 wk from fixed-wing aircraft. Wolf territory boundaries were determined by plotting minimum convex polygons for all locations excluding extra-territorial forays and migratory movements (Ballard, 1993). Total numbers of wolves observed at each location were recorded and used for estimating pack sizes during autumn and spring. Numbers of pups produced each year were estimated by direct counts from fixed-wing aircraft at den and rendezvous sites. We assumed a biological year began on 1 May (Ballard, 1993). We calculated annual finite rates of increase (λ) based upon the total numbers of wolves observed within radio-collared wolf packs each autumn (Ballard et al., 1987).

Annual survival and cause-specific mortality rates were calculated using the methods of Heisey and Fuller (1985).

Blood samples were collected from captured wolves which had been immobilized with a mixture of tiletamine hydrochloride and zolazepan hydrochloride (Ballard et al., 1991). Sera were tested for evidence of exposure to rabies virus by means of the rapid fluorescent focus inhibition test (Smith et al., 1973). When possible we collected skulls from dead wolves. When exact dates of death were unknown we used the median date between when the wolf was last observed alive and when death was confirmed. Skulls were mailed frozen to the Public Health Laboratory in Fairbanks, Alaska, and were checked for rabies with a fluorescent antibody test (Webster and Casey, 1988). The Chi-square test was based on Ott (1988).

RESULTS

Between 1989 and 1990, four radio-collared wolves was confirmed rabid by laboratory examination. Another seven radio-collared wolves died between 1989 and 1991 and had decomposed to the point where laboratory examination was not possible. Ten deaths occurred during May through September and one during December. Ten of the 11 mortalities were females. Age structure of the mortalities was as follows: six were 1 to 2 yr old, three were 2 to 3 yr old, one adult (>2 yr) was unaged, and the single male was 4.3 years old. Total known or suspected mortality due to rabies during 1989 to 1990 and 1990 to 1991 to the six packs was as follows: five of 21, two of two, one of seven, one of four, one of two, and one of one. These are minimum estimates of the extent of the epizootic because many wolves were not radio-collared. One uncollared wolf of unknown pack origin was killed by a hunter approximately 20 km west of Ambler, Alaska (within Nuna Creek pack territory) and was confirmed to have rabies, raising the total number of confirmed cases to five.

Prior to the rabies epizootic, the wolf population increased (λ) during 1987 to 1988 and 1988 to 1989 at rates of 1.43 and 1.05, respectively. However, during the rabies epizootic of 1989 to 1990 and 1990 to 1991, the wolf population declined (λ = 0.64 and 0.62, respectively). Annual wolf survival rates prior to the epizootic ranged from 0.59 to 0.66 but during and following the epizootic they declined and ranged from 0.46 to 0.48. Although annual survival rates were not significantly different among years (chi-square = 1.3, $P > 0.05$), relatively small sample sizes resulted in low power to detect statistical differences. No rabies mortality occurred during 1987 to 1988 and 1988 to 1989 but cause-specific mortality rates during the epizootic were 19% and 7% during 1989 to 1990 and 1990 to 1991, respectively.

Two (2.4%) of 83 sera tested during spring 1987 through 1991 had evidence of exposure to rabies virus: one of seven in 1987, one of 10 in 1988, zero of 23 in 1989, zero of 28 in 1990, and zero of 15 in 1991. Animals tested between 1989 and 1991 included wolves that ultimately died of rabies from 14 to 141 days ($\bar{x}$ = 58 days) after being tested.

DISCUSSION

In the summer it was difficult to recover carcasses prior to the onset of decomposition. However, since there were no evident physical injuries in these wolves and summer mortalities are rare (Ballard et al., 1987), we concluded that rabies was likely the cause of death in these animals. Thus, during the 3 year period, at least 11 radio-collared wolves in six packs may have died from rabies. Reports of rabies virus within Alaska are almost exclusively along coastal regions in southwestern and northern portions of Alaska where red (*Vulpes vulpes*) and arctic foxes (*Alopex lagopus*) are the primary hosts (Ritter, 1981). However, the virus may occasionally occur in interior areas, although cases in either wild or domestic canids are rare (Ritter, 1981). Zarnke and Ballard (1987) reported a low serum antibody prevalence for rabies in wolves from south-central Alaska between 1975 to 1982 (one of 88, 1%). Rabies is usually fatal to mammals. Therefore, the

low serum antibody prevalence we found during this study was not unexpected.

The Nuna Creek pack was most affected by the rabies epizootic. The pack declined in numbers from 24 in autumn 1989 to three by autumn 1990. We do not know if reductions in pack size were due entirely to rabies because wolves disperse and many legally- and illegally-killed wolves are not reported (Ballard, 1993). However, a minimum of five rabies cases was confirmed or suspected in this pack. Although a minimum of five pups were produced in 1990, they apparently did not survive. Only three wolves, believed to be adults, were present during autumn 1990. The three wolves survived the winter and entered the denning season. By autumn 1991, the pack numbered 19, evidence that the rabies epizootic had ended. Possible explanation for the large increase in pack size include: pack size was under-estimated during winter 1990 to 1991, merging of other wolves into the existing pack, or production of two litters within the pack. Multiple litters in wolf packs have been previously reported in other wolf populations (Harrington et al., 1982; Ballard et al., 1987), but none were found in northwest Alaska (Ballard, 1993). Although we documented several radio-collared wolves dispersing and joining existing wolf packs (Ballard, 1993), all of these cases consisted of pairs or single wolves which could not have accounted for the large increase in pack size which was observed.

Rabies epizootics have occurred previously in northwest Alaska. Of the three known human deaths resulting from rabies, all have occurred in northwest Alaska; two were from wolf bites and one from a dog (Ritter, 1991). During 1985 there was an epizootic in wolves in northeast Alaska (Weiler et al., 1995). Nine wolves from several different packs died, but the epizootic did not appear to affect population size; however, it did alter annual den use patterns.

Chapman (1978) observed that some infected wolves remained in familiar areas. He hypothesized that they were unlikely to spread the disease to other wolf packs. In our study, the packs known to have contacted rabies all had territories that abutted against other infected packs. Several avenues of contact were possible: infected wolves contacted other wolves along territory boundaries, infected wolves dispersed into other territories, wolves contacted the virus from foxes or other species, or the virus was ingested. All known mortalities occurred within the known territorial boundaries of each pack and no dispersing wolves were known to have died from rabies. Distances from known den sites at the time of mortality ranged up to 22 km. Wolves in this area are generally not migratory (Ballard, 1993). However, some packs may occasionally follow migratory caribou (*Rangifer tarandus granti*) and some wolves disperse. Contacts between rabid arctic and red foxes and wolves are probably most likely to spread the disease from pack to pack in northwest Alaska. Based upon reported cases, rabies was present in fox populations during 1991 but at lower levels than during 1989 and 1990 (Ritter, 1991).

A total of 140 cases of rabies was confirmed in canid species between 1971 and 1992 in northwest Alaska (D. Ritter, pers. comm.). These figures are minimum estimates because not all cases are reported or found. Arctic and red foxes accounted for 82% of the reported cases. From 1985 to 1992, an average of 18 cases/year were reported. Thirteen of the 18 cases of rabies within dogs and wolves were reported during this period. Foxes occurred within all wolf pack territories.

Rabies can probably eliminate entire wolf packs (Chapman, 1978), alter den site usage (Weiler et al., 1995), and can be a significant population limiting factor (this study). Although hunting and trapping was the most important source of wolf mortality during this study, accounting for 69% of all known mortalities (34 of 54) to radio-collared wolves between 1987 and 1992

(Ballard, 1993), the wolf population was increasing prior to the epizootic but declined during it. Rabies was responsible for 21% (11 of 52) of all known mortalities to radio-collared wolves between 1987 and 1992 (Ballard, 1993), and was a significant source of mortality to this population.

The three recent documented accounts of rabies in Alaskan wolf populations (Chapman, 1978; Weiler et al., 1995; this study) were discovered during short-term studies of wolf ecology using radio-telemetry. Without radio-telemetry, most deaths from rabies would have gone unnoticed because few rabid wolves are reported by the public. Maintaining long-term contact with several wolf populations in different geographic areas may ultimately provide additional insight into the role of rabies in limiting or regulating wolf populations.

ACKNOWLEDGMENTS

The study was funded by the U.S. National Park Service, the Alaska Department of Fish and Game, the U.S. Fish and Wildlife Service, and several Alaska Federal Aid to Restoration Projects. Publication costs were financed by The University of Arizona, Arizona Agricultural Experiment Station, Tucson. D. Ritter generously shared his unpublished data concerning the historical occurrence of rabies in Alaskan wolves. R. Zarnke made arrangements for testing of blood sera. I thank L. A. Ayres, J. Dau, T. Smith, and J. Rood for their assistance in the field. V. Crichton and H. A. Whitlaw reviewed early drafts of the manuscript.

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Received for publication 19 October 1995.