SEROLOGIC SURVEY OF SELECTED CANINE PATHOGENS AMONG FREE-RANGING JACKALS IN KENYA

Authors: Alexander, K. A., Kat, P. W., Wayne, R. K., and Fuller, T. K.

Source: Journal of Wildlife Diseases, 30(4) : 486-491

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-30.4.486

Journal of Wildlife Diseases, 30(4), 1994, pp. 486–491

SEROLOGIC SURVEY OF SELECTED CANINE PATHOGENS AMONG FREE-RANGING JACKALS IN KENYA

K. A. Alexander,[1] P. W. Kat,[1,2] R. K. Wayne,[3] and T. K. Fuller[4]

[1] Department of Veterinary Pathology, Microbiology, and Immunology, University of California, Davis, California, 95616, USA
[2] Wildlife Concern International, 9922 Walzer Way, Windermere, Florida, 34786, USA
[3] Department of Biology, University of California, Los Angeles, California, 90024, USA
[4] Department of Forestry and Wildlife Management, University of Massachusetts, Amherst, Massachusetts, 01003, USA

ABSTRACT: Serum samples from 76 free-ranging adult jackals of three species from four localities in Kenya were examined for circulating antibodies against four canine pathogens: rabies virus, canine parvovirus (CPV-2), canine distemper virus (CDV), and *Ehrlichia canis*. Samples were collected between April 1987 and January 1988. Among black-backed jackals (*Canis mesomelas*), the most sampled species, the mean prevalence of antibodies to CPV-2, CDV, rabies virus, and *E. canis* was 34% (14 positive/55 sampled), 9% (4/55), 3% (1/28), and 2% (1/36), respectively. There were no significant differences among sampling locations. In one area, antibody prevalence of CPV-2 was significantly higher for golden jackals (*C. aureus*; 9/16) than for *C. mesomelas* (5/26). Only three side-striped jackals (*C. adustus*) were sampled, but antibodies to CPV-2 and CDV were present. As jackals often are the most abundant wild carnivore in African ecosystems, they could serve as an important indicator species to monitor the potential of exposure of rare and endangered canids to specific canine diseases.

Key words: Jackal, *Canis* spp, canine distemper virus, canine parvovirus, rabies, *Ehrlichia canis*, serologic survey.

INTRODUCTION

Jackals occur in a wide variety of habitats in sub-Saharan Africa and central Asia (Kingdon, 1977). Black- or silver-backed (*Canis mesomelas*), side-striped (*C. adustus*), and golden (*C. aureus*) jackals are morphologically similar (Wayne et al., 1989) and sympatric in western Kenya. Adult jackals are territorial with home range sizes usually varying between 1 to 40 km² (Fuller et al., 1989), but juveniles may disperse up to 842 km from natal areas (Ferguson et al., 1983). This long-range dispersal capability may have important implications in disease transmission.

Jackals are versatile predators, hunting small mammals, birds, and invertebrates, but also scavenging from carcasses and utilizing a variety of plant foods (Lamprecht, 1978). Their high degree of habitat tolerance and adaptability allows them to frequent the vicinity of human settlements (Skinner and Smithers, 1990) where they feed on a variety of refuse (Macdonald, 1979) and domestic animal carcasses. Jackals have been reported to be susceptible to a large spectrum of canine pathogens commonly found in domestic dogs (*Canis familiaris*), including rabies (Foggin, 1988), *Babesia canis* (van Heerden, 1980), *Ehrlichia canis* (van Heerden, 1979), *Leishmania donovani* and *Toxoplasma gondii* (van der Merwe, 1953), *Ancylostoma caninum* (Gupta and Kalia, 1988) and *Echinococcus granulosus* (Macpherson et al., 1983). With few exceptions, however, the clinical implications of such infections have not been documented.

Our objective was to determine the antibody prevalence of four important canine diseases, canine parvovirus, canine distemper, rabies and ehrlichiosis, among jackals sampled on private ranches at four localities in Kenya.

MATERIALS AND METHODS

Jackals were sampled on game and livestock ranches at four different sites in Kenya in connection with ecologic (Fuller et al., 1989) and genetic (Wayne et al., 1989) studies. The sites were located about 20 km south of Nairobi at Athi River (36°56'E, 1°29'S; January 1988; n =

TABLE 1. The proportion of adult jackals testing positive for antibodies to canine parvovirus (CPV-2), canine distemper virus (CDV), *Ehrlichia canis*, and rabies in four areas of Kenya (April 1987–January 1988).

Species	Location	Number positive/number tested			
		CPV-2	CDV	*E. canis*	Rabies
Canis mesomelas	Athi River	2/14	2/14	0/11	0/7
	Laikipia	5/11	0/11	1/9	1/6
	Masai Mara	2/4	0/4	0/3	0/2
	Nakuru	5/26	2/26	0/16	0/13
Canis aureus	Nakuru	9/16	0/16	0/8	0/8
Canis adustus	Nakuru	1/3	1/3	—	—

14), 25 km west of Nanyuki on the Laikipia plateau (36°56′E, 0°11′N; July 1987; $n = 13$), 10 km south of Nakuru in the Rift Valley (36°14′E, 0°29′S; June 1987; $n = 45$) and on group ranches near the Masai Mara National Reserve in southwest Kenya (35°04′E, 1°12′S; April 1987; $n = 4$). Jackals were captured in rubber-padded steel foot-hold traps (Victor "Soft-Catch" for foxes; Woodstream Corp., Lititz, Pennsylvania, USA) and 25 × 30 × 81 cm or 38 × 38 × 107 cm cage-type live traps (Tomahawk Live Trap Company, Tomahawk, Wisconsin, USA), which were baited with fresh meat and commercially-prepared canid lure (Pete Rickard, Inc., Cobleskill, New York, USA). Trapped jackals were immobilized with either 130 mg ketamine hydrochloride (Bristol-Meyers Company, Syracuse, New York, USA) and 15 mg promazine hydrochloride (Wyeth Laboratories, Inc., Philadelphia, Pennsylvania, USA), or 15 mg Telazol® (tiletamine hydrochloride and zolazepam hydrochloride; Aveco Company, Inc., Fort Dodge, Iowa, USA) administered by hand-held syringes. Anesthesia was maintained for 30 to 55 min. Blood samples were collected from the lateral saphenous vein or the jugular vein, and sera obtained was stored at −20 C until tested. Serologic tests were performed within two years of collection.

Sera were evaluated for the presence of antibodies against canine parvovirus (CPV-2), canine distemper virus (CDV), rabies virus, and *Ehrlichia canis*. The hemagglutination inhibition test using CPV-2 antigen was used to detect serum antibodies for parvovirus and a titer of >1:320 established a positive classification (Carmichael et al., 1980). Serum antibodies to CDV were measured using a microneutralization test with log titers >1.0 considered a positive reaction (Appel and Robson, 1973). Neutralizing antibodies to rabies virus were detected using a modified rapid fluorescent focus inhibition test (Smith et al., 1973). Titers were expressed in International Units (IU)/ml determined by comparison with standard serum and ≥0.5 IU was considered seropositive based on the WHO standard for human vaccination. An immunofluorescent antibody test (IFA) was used to determine serum antibody titers for *E. canis*, using antigen smears of in vitro cultivated, *E. canis*-infected mononuclear cells (Ristic et al., 1972). Titers of >1:80 were considered positive. Not all samples were tested for each agent because of toxic reactions in cell culture or lack of sufficient serum. The proportions of seropositive animals between species and among locations were compared by Yates-corrected chi-square statistics (Martin et al., 1987).

RESULTS

There were no significant differences ($P > 0.16$) in proportions of seropositive individuals between sampling locations for the most commonly sampled species, *C. mesomelas* (Table 1). Antibodies were found in 14 of 55 *C. mesomelas* tested for CPV-2, with confidence intervals (c.i.) of 15 to 36%, in four of 55 tested for CDV (c.i. = <1 to 14%), in one of 39 tested for *E. canis* (c.i. = 0–8%), and in one of 28 tested for rabies virus (c.i. = 0–11%). At Nakuru, antibodies to CPV-2 occurred in nine of 16 golden jackals and in five of 26 *C. mesomelas*; this difference was significant ($P = 0.03$). Only three side-striped jackals were sampled, all at Nakuru, but prevalence of antibodies to both CPV-2 and CDV was noted.

DISCUSSION

The natural host range of CPV-2 currently is undetermined, but most Canidae appear to be susceptible. Canine parvovirus was panzootic among domestic dogs

by 1980 (Appel and Parish, 1987) and epizootics have been reported among captive exotic canids such as maned wolves (*Chrysocyon brachyurus*), bush dogs (*Speothos venaticus*), and crab-eating foxes (*Cerdocyon thous*) (Mann et al., 1980). In earlier serologic surveys for CPV-2 antibodies among free-ranging non-African canid populations such as wolves (*Canis lupus*) (Goyal et al., 1986), coyotes (*C. latrans*) (Thomas et al., 1984), island foxes (*Urocyon littoralis*) (Garcelon et al., 1992), and red foxes (*Vulpes vulpes*) (Barker et al., 1983), workers reported antibody prevalences from 50 to >70%. In this study, 24 (32%) of 74 jackals tested had antibodies for CPV-2. Prevalence of antibodies to CPV-2 among jackals was similar to that noted during a serologic survey of Kenyan domestic dogs conducted during 1989 to 1991 in the Masai Mara, Kenya where 51 (22%) of 232 dogs were seropositive for CPV-2 (Alexander et al., 1993). The temporal dynamics of infection and serologic responses to CPV-2 and other viruses may contribute to variation in prevalence rates. Such factors should be considered when comparing seroprevalence levels of antibodies between studies. The clinical implications of CPV-2 infections among jackals are unknown.

Canine distemper is a common, highly infectious disease of wild and domestic canids (Budd, 1981). Eight of the 11 families of carnivores have been reported to be susceptible to this viral disease (Montali et al., 1987). The natural history of CD in free-ranging carnivores has not been extensively studied, but CD epizootics have occurred among black-footed ferrets (*Mustela nigripes*) (Williams et al., 1988), raccoon dogs (*Nyctereutes procyonoides*) (Machida et al., 1993), and skunks (*Mephitis mephitis*) (Hemboldt and Jungherr, 1955). Canine distemper was the most significant cause of natural mortality among gray foxes (*Urocyon cinereoargenteus*) sampled over 17 yr in the southeastern United States (Davidson et al., 1992). In Kenya, we observed a low prevalence of antibodies to CDV (9%, $n = 76$) among jackal populations at the time of testing. Although CDV is endemic in most areas of the world, Appel (1987) states that this may not be true for hot, arid regions, such as parts of Africa. The clinical implication of this infection in free-ranging jackal populations is unknown, although the Masai Mara jackal population in Kenya was thought to have declined coincident with a distemper outbreak among sympatric domestic dogs (Alexander and Appel, 1994).

Canine ehrlichiosis is a tick-borne disease caused by the rickettsia *Ehrlichia canis*. The disease has a worldwide distribution, and is common among domestic dogs in eastern Africa (Troy and Forrester, 1990). Price and Karstad (1980) identified *E. canis* morulae from the blood of eight of 16 free-ranging jackals using a modified cell culture test. Only one jackal tested in this study, however, had a level of antibodies to *E. canis* considered to be specific. This difference can be attributed to several possible factors, including a low level of exposure to the pathogen (perhaps related to seasonal variation in vector tick density), limited or negligible antibody response to infection, or a lack of test specificity. The first hypothesis is supported by a similar trend of variable levels of seropositivity among domestic dogs sampled from the Masai Mara area (Alexander et al., 1993). There, antibody prevalence varied annually from 6% (1/16) in 1989 to 16% (21/132) in 1990 to 76% (39/51) in 1991 among domestic dogs sampled between July and August each year. To our knowledge, jackals never have been examined simultaneously for presence of the pathogen by hematology as well as serology. Thus, it is not known whether jackals exhibit similar antibody responses to infection as noted among domestic dogs. Van Heerden (1979) reported that jackals appeared to be asymptomatic when experimentally infected through the inoculation of blood

from an *E. canis*-infected domestic dog but he presented no serologic test results. Thus it is not possible at this time to discount a limited immune response as an explanation for low antibody prevalence among jackals. Finally, the IFA test used is sensitive and specific for a variety of *E. canis* isolates (Ristic et al., 1972), and, given the domestic dog results, there is no *a priori* reason to question test specificity.

Rabies is widespread in Africa, and has become endemic in many areas of Kenya (Binepal, 1992). Jackals have been one of the main wildlife species implicated in the transmission of rabies in southern Africa; for example, 23% of the total confirmed rabies cases in Zimbabwe from 1950 to 1986 involved jackals (Foggin, 1988). The prevalence of rabies viral antibodies among wild carnivores generally is low and the significance of such antibodies is unclear. Among certain wildlife species, antibodies to rabies virus have been detected in varying, but low levels with 6% in raccoons (*Procyon lotor*) (Hill et al., 1992) and 1% among wolves (Zarnke and Ballard, 1987) in the USA, and 3% among jackals in Zimbabwe (Foggin, 1988). Similarly, in this study, only 3% (1/28) of the jackals tested had antibodies against rabies virus.

As human populations continue to encroach on wildlife habitat in Africa, contact between domestic animals and jackals will increase. This trend could have significant implications as jackals are also frequently in contact with wild carnivores when they scavenge from kills of lions (*Panthera leo*) and spotted hyenas (*Crocuta crocuta*) (Kingdon, 1977). Thus, they could serve as an important link in disease transmission between domestic animals and wild carnivores. In addition, since jackals are often the most abundant wild carnivore in many African ecosystems (Wyman, 1967), they could serve as a useful indicator species for monitoring the prevalence of specific canine diseases. Such monitoring could provide important information regarding the potential of disease exposure for rare and endangered canids such as the African wild dog (*Lycaon pictus*).

ACKNOWLEDGMENTS

We are grateful for the financial and field support of B. Van Valkenburgh and the field assistance of D. Girman. We also thank P. Behr, B. Gasston, D. Hopcraft, G. Grant, the Narok County Council, and the Koiyagi Group Ranch for permission to work on the properties under their management. The Kenya Wildlife Conservation and Management Department provided encouragement and assistance with this research. C. Parish (parvovirus), M. Appel (distemper), M. Levy and R. Gager (ehrlichiosis), and A. King (rabies) performed the serologic analyses, and we appreciate all the time and effort they devoted to this study. We thank B. Perry and two anonymous reviewers for their valuable comments on this manuscript. The Kenya Agricultural Research Institute provided sponsorship of K. Alexander's research activities in Kenya, and this paper is published with the kind permission of the Director of KARI.

LITERATURE CITED

ALEXANDER, K. A., AND M. J. G. APPEL. 1994. African wild dogs (*Lycaon pictus*) endangered by a canine distemper epizootic among domestic dogs near the Masai Mara National Reserve, Kenya. Journal of Wildlife Diseases 30: 481–485.

———, P. A. CONRAD, I. A. GARDNER, C. PARISH, M. APPEL, M. G. LEVY, N. LERCHE, AND P. W. KAT. 1993. Serologic survey of selected canine pathogens in African Wild Dogs (*Lycaon pictus*) and sympatric domestic dogs in Masai Mara, Kenya. Journal of Zoo and Wildlife Medicine 24: 140–144.

APPEL, M. 1987. Canine distemper. *In* Virus infections of carnivores, Vol. 1, M. G. J. Appel (ed.). Elsevier Science Publishers, B.V., Amsterdam, The Netherlands, pp. 133–159.

———, AND C. R. PARISH. 1987. Canine parvovirus type 2. *In* Virus infections of carnivores, M. Appel (ed.). Elsevier Science Publishers, B.V., Amsterdam, The Netherlands, pp. 69–92.

———, AND D. S. ROBSON. 1973. A microneutralization test for canine distemper virus. American Journal of Veterinary Research 34: 1459–1463.

BARKER, I. K., R. C. POVEY, AND D. R. VOIGHT. 1983. Response of mink, skunk, red fox and raccoon to inoculation with mink enteritis virus, feline panleukopenia and canine parvovirus and prevalence of antibody to parvovirus in wild car-

nivores in Ontario. Canadian Journal of Comparative Medicine 47: 188–197.

BINEPAL, Y. 1992. Rabies in Kenya. *In* Proceedings of the International Conference on epidemiology, control and prevention of rabies in eastern and southern Africa, Lusaka, Zambia, A. King (ed.). Editions Fondation Marcel Merieux, Lyon, France, pp. 14–16.

BUDD, J. 1981. Distemper. *In* Infectious disease of wild mammals, 2nd ed., J. W. Davis, L. H. Karstad, and D. O. Trainer (eds.). The Iowa State University Press, Ames, Iowa, pp. 31–44.

CARMICHAEL, L. E., J. C. JOUBERT, AND R. V. POLLOCK. 1980. Hemagglutination of canine parvovirus: Serologic studies and diagnostic applications. American Journal of Veterinary Research 40: 784–791.

DAVIDSON, W. R., V. F. NETTLES, L. E. HAYES, E. W. HOWERTH, AND C. E. COUVILLION. 1992. Diseases diagnosed in gray foxes (*Urocyon cinereoargentatus*) from the southeastern United States. Journal of Wildlife Diseases 28: 28–33.

FERGUSON, J. W. H., J. A. J. NEL, AND M. J. DE WET. 1983. Social organization and movement patterns of black-backed jackals *Canis mesomelas* in South Africa. Journal of Zoology 199: 55–69.

FOGGIN, C. M. 1988. Rabies and rabies related viruses in Zimbabwe. Historical, virological, and ecological aspects. D. Phil. Thesis. Faculty of Medicine, University of Zimbabwe, Harare, Zimbabwe, 262 pp.

FREUND, J. E. 1970. Statistics: A first course. Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 340 pp.

FULLER, T. K., A. R. BIKNEVICIUS, P. W. KAT, B. VAN VALKENBURGH, AND R. K. WAYNE. 1989. The ecology of three sympatric jackal species in the Rift Valley of Kenya. African Journal of Ecology 27: 313–323.

GARCELON, D. K., R. K. WAYNE, AND B. J. GONZALES. 1992. A serologic survey of the Island fox (*Urocyon littoralis*) on the Channel Islands, California. Journal of Wildlife Diseases 28: 223–229.

GOYAL, S. G., L. D. MECH, R. A. RADEMACHER, M. A. KHAN, AND U. S. SEAL. 1986. Antibodies against canine parvovirus in wolves of Minnesota: A serologic study from 1975 through 1985. Journal of the American Veterinary Medical Association 189: 1092–1094.

GUPTA, N. K., AND D. C. KALIA. 1988. Remarks on two already known nematode parasites from an Indian jackal. Research Bulletin of the Punjab University, Science 39: 227–231.

HEMBOLDT, E. L., AND E. L. JUNGHERR. 1955. Distemper complex in wild carnivores simulating rabies. American Journal of Veterinary Research 16: 463–469.

HILL, R. E., G. W. BERAN, AND W. R. CLARK. 1992. Demonstration of rabies virus-specific antibody in the sera of free-ranging Iowa raccoons (*Procyon lotor*). Journal of Wildlife Diseases 28: 377–385.

KINGDON, J. 1977. East African mammals, Vol. IIIA (carnivores). Academic Press, London, England, pp. 13–35.

LAMPRECHT, J. 1978. On the diet, foraging behavior and interspecific food competition of jackals in the Serengeti National Park, East Africa. Zeitung für Saugetierkunde 43: 210–223.

MACDONALD, D. W. 1979. The flexible social system of the golden jackal (*Canis aureus*). Behavioral Ecology and Sociobiology 5: 17–38.

MACHIDA, N., K. KIRYU, K. OH-ISHI, E. KANDA, N. IZUMISAWA, AND T. NAKAMURA. 1993. Pathology and epidemiology of canine distemper in raccoon dogs (*Nyctereutes procyonoides*). Journal of Comparative Pathology 108: 383–392.

MACPHERSON, C. N. L., L. KARSTAD, P. STEVENSON, AND J. H. ARUNDEL. 1983. Hydatid disease in the Turkana district of Kenya. III. The significance of wild animals in the transmission of *Echinococcus granulosus*, with particular reference to Turkana and Masailand in Kenya. Annals of Tropical Medicine and Parasitology 77: 61–73.

MANN, P. C., M. BUSH, M. G. APPEL, B. A. BEEHLER, AND R. J. MONTALI. 1980. Canine parvovirus infection in South American canids. Journal of the American Veterinary Medical Association 177: 779–783.

MARTIN, S. W., A. H. MEEK, AND P. WILLEBERG. 1987. Veterinary epidemiology. Iowa State University Press, Ames, Iowa, 343 pp.

MONTALI, R. J., C. R. BARTZ, AND M. BUSH. 1987. Canine distemper virus. *In* Virus infections of carnivores, M. Appel (ed.). Elsevier Science Publishers, B.V., Amsterdam, pp. 133–159.

PRICE, J. E., AND L. H. KARSTAD. 1980. Free-living jackals (*Canis mesomelas*)—Potential reservoir hosts for *Ehrlichia canis* in Kenya. Journal of Wildlife Diseases 16: 469–473.

RISTIC, M., D. L. HUXSOLL, R. M. WEISIGER, P. K. HILDEBRAND, AND M. B. A. NYINDO. 1972. Serological diagnosis of tropical canine pancytopenia by indirect immunofluorescence. Infection and Immunity 6: 226–231.

SKINNER, J. D., AND R. H. N. SMITHERS. 1990. The mammals of the southern African subregion, 2nd ed. University of Pretoria, Pretoria, South Africa, pp. 441–445.

SMITH, J. S., P. A. YAGER, AND G. M. BAER. 1973. Rapid fluorescent focus inhibition test. Bulletin of the World Health Organization 48: 535–541.

THOMAS, N. J., W. J. FOREYT, J. F. EVERMANN, L. A. WINDBERG, AND F. F. KNOWLTON. 1984. Seroprevalence of canine parvovirus in wild coyotes from Texas, Utah, and Idaho (1972 to 1983). Journal of the American Veterinary Medical Association 185: 1283–1287.

TROY, G. C., AND S. D. FORRESTER. 1990. *Ehrlichia canis, E. equi,* and *E. risticii* infections. *In* Infectious diseases of the dog and cat, C. E. Greene (ed.). W.B. Saunders Company, Philadelphia, Pennsylvania, pp. 404–414.

VAN DER MERWE, N. J. 1953. The jackal. Fauna and Flora, Pretoria 4: 3–83.

VAN HEERDEN, J. 1979. The transmission of canine ehrlichiosis to the wild dog *Lycaon pictus* (Temminck) and black-backed jackal *Canis mesomelas* Schreber. Journal of the South African Veterinary Medical Association 50: 245–248.

———. 1980. The transmission of *Babesia canis* to the wild dog *Lycaon pictus* (Temminck) and black-backed jackal *Canis mesomelas* Schreber. Journal of the South African Veterinary Medical Association 51: 119–120.

WAYNE, R. K., B. VAN VALKENBURGH, P. W. KAT, T. K. FULLER, W. E. JOHNSON, AND S. J. O'BRIEN. 1989. Genetic and morphological divergence among sympatric canids. Journal of Heredity 80: 447–454.

WILLIAMS, E. S., E. T. THORNE, M. J. G. APPEL, AND D. W. BELITSKY. 1988. Canine distemper in black-footed ferrets (*Mustela nigripes*) from Wyoming. Journal of Wildlife Diseases 24: 385–398.

WYMAN, J. 1967. The jackals of the Serengeti. Animals 10: 79–83.

ZARNKE, R. L., AND W. B. BALLARD. 1987. Serologic survey for selected microbial pathogens of wolves in Alaska, 1975–1982. Journal of Wildlife Diseases 23: 77–85.

Received for publication 18 October 1993.