

**Supplementary materials for Journal of Wildlife Diseases DOI: 10.7589/2017-09-238:
Darren J Wostenberg, Nikki Walker, Karen A Fox, Terry R Spraker, Antoinette J Piaggio,
and Amy Gilbert, Evidence of Two Co-circulating Canine Distemper Viral Strains in
Mesocarnivores from Northern Colorado**

SUPPLEMENTARY TABLE

Supplementary Table 1 Table of GenBank accession number, isolate description, species description, and isolate citation of canine distemper virus hemagglutinin gene sequences used for phylogenetic comparison of international clades of CDV. The morbillivirus phocine distemper virus (PDV) was included as outgroup.

GenBank Accession #	Isolate Description	CDV Clade	Species Description	Isolate Citation
FJ461703	6L	Africa	Dog	Woma et al. 2010
FJ461723	23sp	Africa	Dog	Woma et al. 2010
AY466011	98-2654	America-1	Raccoon	Lednicky et al. 2004b
AY542312	98-2646	America-1	Raccoon	Lednicky et al. 2004a
AY438597	00-2601	America-2	Raccoon	Lednicky et al. unpublished
AY526496	01-2641	America-2	Raccoon	Lednicky et al. 2004a
AY649446	01-2689	America-2	Raccoon	Lednicky et al. unpublished
Z47764	US89	America-2	Javelina	Bolt et al. 1997
AY964110	19876	America-3	Dog	Pardo et al. 2005
HM771716	Endomex10	America-3	Dog	Gámiz et al. 2011
HM771718	GDL1	America-3	Dog	Gámiz et al. 2011

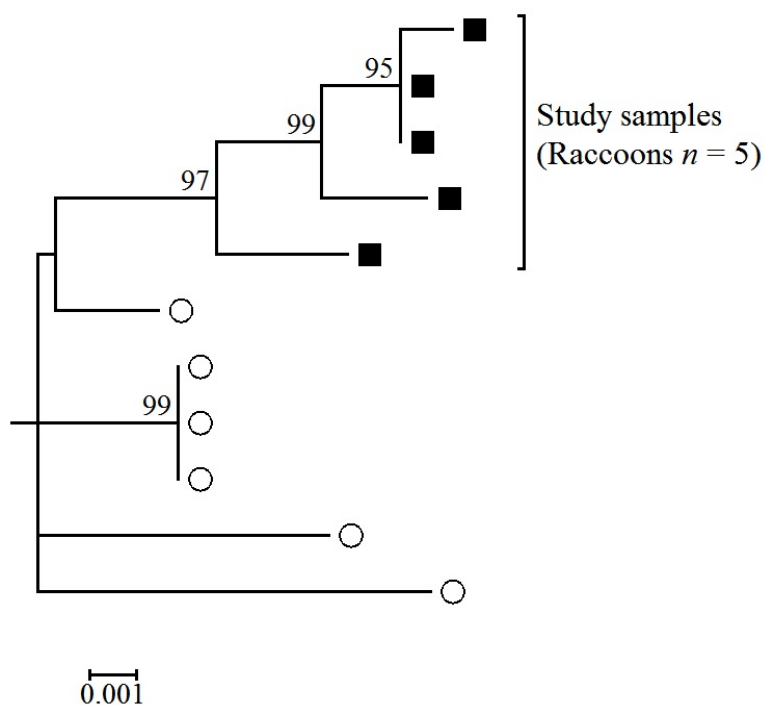
JN836734	Fisher1	America-3	Fisher	Keller et al. 2012
JN836735	Fisher3	America-3	Fisher	Keller et al. 2012
JN836736	Fisher3	America-3	Fisher	Keller et al. 2012
KJ747371	13-1941	America-4	Fox	Riley and Wilkes 2015
KJ747372	13-2262	America-4	Dog	Riley and Wilkes 2015
AY964108	18133	Artic-like	Dog	Pardo et al. 2005
DQ226088	48/05	Artic-like	Dog	Martella et al. 2006
Z47760	GR88	Artic-like	Dog	Bolt et al. 1997
AB025271	KDK1	Asia-1	Dog	Mochizuki et al. 1999
AB212963	Ac96I	Asia-1	Dog	Lan et al. 2006
EF042818	SC01	Asia-1	Raccoon	Zeng et al. unpublished
AB025270	98-002	Asia-2	Dog	Mochizuki et al. 1999
AB040767	HM-3	Asia-2	Dog	Hashimoto et al. 2001
AB212729	007LmT	Asia-2	Dog	Lan et al. 2005
AF478544	DK91A	Europe	Dog	Nielsen et al. 2003
AY386315	5804	Europe	Dog	von Messling et al. 2003
Z77671	404	Europe	Dog	Haas et al. 1997
Z47761	DK91	Europe	Dog	Bolt et al. 1997
DQ228166	207/00	European Wildlife	Red fox	Martella et al. 2006
JN153022	188/07	European Wildlife	Raccoon	Nikolin et al. 2011
Z47759	DK86	European Wildlife	Mink	Bolt et al. 1997
AM422850	Arg5	South America-2	Dog	Calderon et al. 2007
AM422860	Arg15	South America-2	Dog	Calderon et al. 2007

FJ392651	Bruno	South America-2	Dog	Calderon et al. unpublished
KF835420	34-CO/12	South America-3	Dog	Espinal et al. 2014
Z36979	DK88-4a	Outgroup – PDV	Harbor seal	Kövamees et al. 1991

SUPPLEMENTARY FIGURES



Supplementary Figure 1 Phylogram of expanded America-2 clade constructed from canine distemper virus hemagglutinin gene sequences collected from positive raccoons (*Procyon lotor*) and one coyote (*Canis latrans*) in northern Colorado during June 2013 through March 2016, compared to sequences from previous studies. Samples from study are identified by bracket ($n = 55$). Bootstrap values above 60% are shown. The 54 filled squares represent raccoons, the single open square represents a coyote, and the three open circles represent sequences from GenBank listed in Supplementary Table 1.



Supplementary Figure 2 Phylogram of expanded America-3 clade constructed from canine distemper virus hemagglutinin gene sequences collected from positive raccoons (*Procyon lotor*) in northern Colorado during June 2013 through March 2016, compared to sequences from previous studies. Samples from study are identified by bracket ($n = 5$). Bootstrap values above

60% are shown. The five filled squares represent raccoons and the four open circles represent sequences from GenBank listed in Supplementary Table 1.

LITERATURE CITED

- Bolt G, Jensen TD, Gottschalck E, Arctander P, Appel M, Buckland R, and Blixenkroner M. 1997. Genetic diversity of the attachment (H) protein gene of current field isolates of canine distemper virus. *J Gen Virol* 78: 367-372.
- Calderon MG, Remorini P, Periolo O, Iglesias M, Mattion N, and La Torre J. 2007. Detection by RT-PCR and genetic characterization of canine distemper virus from vaccinated and non-vaccinated dogs in Argentina. *Vet Microbiol* 125: 341-349.
- Espinal MA, Díaz FJ, and Ruiz-Saenz J. 2014. Phylogenetic evidence of a new canine distemper virus lineage among domestic dogs in Colombia, South America. *Vet Microbiol* 172: 168-176.
- Gámiz C, Martella V, Ulloa R, Fajardo R, Quijano-Hernández I, and Martínez S. 2011. Identification of a new genotype of canine distemper virus circulating in America. *Vet Res Commun* 35: 381-390.
- Haas L, Martens W, Greiser-Wilke I, Mamaev L, Butina T, Maack D, and Barrett T. 1997. Analysis of the haemagglutinin gene of current wild-type canine distemper virus isolates from Germany. *Virus Res* 48: 165-171.
- Hashimoto M, Une Y, and Mochizuki M. 2001. Hemagglutinin genotype profiles of canine distemper virus from domestic dogs in Japan. *Arch Virol* 146: 149-155.

- Keller SM, Gabriel M, Terio KA, Dubovi EJ, VanWormer E, Sweitzer R, Barret R, Thompson C, Purcell K, and Munson L. 2012. Canine distemper in an isolated population of fishers (*Martes pennanti*) from California. *J Wildl Dis* 48: 1035-1041.
- Kövamees J, Blixenkron-Möller M, and Norrby E. 1991. The nucleotide and predicted amino acid sequence of the attachment protein of canine distemper virus. *Virus Res* 19: 223-233.
- Lan N, Yamaguchi R, Furuya Y, Inomata A, Ngamkala S, Naganobu K, Kai K, Mochizuki M, Kobayashi Y, and Uchida K. 2005. Pathogenesis and phylogenetic analyses of canine distemper virus strain 007Lm, a new isolate in dogs. *Vet Microbiol* 110: 197-207.
- Lan N, Yamaguchi R, Inomata A, Furuya Y, Uchida K, Sugano S, and Tateyama S. 2006. Comparative analyses of canine distemper viral isolates from clinical cases of canine distemper in vaccinated dogs. *Vet Microbiol* 115: 32-42.
- Lednický JA, Dubach J, Kinsel MJ, Meehan TP, Bocchetta M, Hungerford LL, Sarich NA, Witecki KE, Braid MD, and Pedrak C. 2004a. Genetically distant American Canine distemper virus lineages have recently caused epizootics with somewhat different characteristics in raccoons living around a large suburban zoo in the USA. *Virology* 1: 2.
- Lednický JA, Meehan TP, Kinsel MJ, Dubach J, Hungerford LL, Sarich NA, Witecki KE, Braid MD, Pedrak C, and Houde CM. 2004b. Effective primary isolation of wild-type canine distemper virus in MDCK, MV1 Lu and Vero cells without nucleotide sequence changes within the entire haemagglutinin protein gene and in subgenomic sections of the fusion and phospho protein genes. *J Virol Methods* 118: 147-157.
- Martella V, Cirone F, Elia G, Lorusso E, Decaro N, Campolo M, Desario C, Lucente M, Bellacicco A, and Blixenkron-Møller M. 2006. Heterogeneity within the hemagglutinin

- genes of canine distemper virus (CDV) strains detected in Italy. *Vet Microbiol* 116: 301-309.
- Mochizuki M, Hashimoto M, Hagiwara S, Yoshida Y, and Ishiguro S. 1999. Genotypes of canine distemper virus determined by analysis of the hemagglutinin genes of recent isolates from dogs in Japan. *J Clin Microbiol* 37: 2936-2942.
- Nielsen L, Andersen MK, Jensen TD, Blixenkronne-Møller M, and Bolt G. 2003. Changes in the receptorbinding haemagglutinin protein of wild-type morbilliviruses are not required for adaptation to Vero cells. *Virus Genes* 27: 157-162.
- Nikolin VM, Wibbelt G, Michler F-UF, Wolf P, and East ML. 2011. Susceptibility of carnivore hosts to strains of canine distemper virus from distinct genetic lineages. *Vet Microbiol* 156: 45-53.
- Pardo ID, Johnson GC, and Kleiboeker SB. 2005. Phylogenetic characterization of canine distemper viruses detected in naturally infected dogs in North America. *J Clin Microbiol* 43: 5009-5017.
- Riley MC, and Wilkes RP. 2015. Sequencing of emerging canine distemper virus strain reveals new distinct genetic lineage in the United States associated with disease in wildlife and domestic canine populations. *Virology* 12: 219.
- Von Messling V, Springfield C, Devaux P, and Cattaneo R. 2003. A ferret model of canine distemper virus virulence and immunosuppression. *J Virol* 77: 12579-12591.
- Woma TY, van Vuuren M, Bosman A-M, Quan M, and Oosthuizen M. 2010. Phylogenetic analysis of the haemagglutinin gene of current wild-type canine distemper viruses from South Africa: lineage Africa. *Vet Microbiol* 143: 126-132.