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Source: Journal of Wildlife Diseases, 13(4) : 448-450

Published By: Wildlife Disease Association

URL: <https://doi.org/10.7589/0090-3558-13.4.448>

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CALICIVIRUS ANTIBODIES IN WILD FOX POPULATIONS¹

C. M. PRATO,² T. G. AKERS³ and A. W. SMITH²

Abstract: Three populations of wild foxes were sampled for serum neutralizing antibody to calicivirus (San Miguel sea lion virus) types 1-5. Neutralizing activity was detected in serum from gray foxes resident on Santa Cruz Island, California, but not in Arctic foxes from Alaska. The results indicate that foxes may be naturally infected with caliciviruses, but their role in the transmission cycle is unknown.

INTRODUCTION

In 1972, two serotypes of a calicivirus were isolated from California sea lions (*Zalophus californianus californianus*) on San Miguel Island California.⁵ The viruses designated San Miguel sea lion virus (SMSV) proved to be indistinguishable from Vesicular Exanthema of swine virus (VESV). Since the initial isolation of SMSV three more serotypes have been identified and the virus has been isolated from the northern fur seal (*Callorhinus ursinus*) and the northern elephant seal (*Mirounga augustirostris*).⁴ Presence of neutralizing antibodies indicate that both marine and terrestrial species have been exposed to the virus.^{1,3,6,7}

The range of host cell susceptibility of four SMSV serotypes has been investigated.⁸ The studies show that these viruses replicate in cells from a variety of animals, including the canine kidney. In both geographic areas where isolations of SMSV from pinnipeds have been made (Channel Island of California and Pribilof Islands, Alaska) populations of wild foxes are found. On two of the Channel Islands (Santa Cruz, San Clemente), feral swine were found who evinced serum neutralizing activity to

SMSV serotypes 1, 2 and 5.⁸ Wild boars are hunted and butchered on these islands, providing a source of potentially infected offal available to foraging foxes. Additionally, both foxes and swine may scavenge on the beaches where they may contact pinnipeds or, possibly other marine sources of infection.

We examined sera of two fox species obtained from three separate populations for the presence of neutralizing antibody to four SMSV serotypes. The results are presented in this report.

MATERIALS AND METHODS

Serum collection

Serum samples from 85 island gray fox, *Urocyon littoralis*, were collected on Santa Cruz Island California in March, 1973. A total of 35 sera from the Arctic fox, *Alopex lagopus*, were collected in Alaska in the spring and early summer of 1975. Sixteen of the animals were taken on St. Paul, Pribilof Island, and 19 from the Prudhoe Bay vicinity. Animals were caught in collapsible live traps,⁴ bled by cardiac puncture and released. The harvested serum was frozen, transported to the laboratory and maintained at -20 C until tested.

¹ This work was sponsored by the Office of Naval Research and by National Marine Fisheries Service, Department of Commerce.

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Serum neutralization

Serum neutralization (SN) tests against 4 SMSV serotypes were carried out by the microtiter technique as previously described,⁷ using 100 TCID₅₀ of virus in vero cell monolayers. Antibody titers were calculated as the serum dilution neutralizing 50% of microtiter wells.

RESULTS AND DISCUSSION

The results of SN tests on the three wild fox populations show positive reactors in Southern California but not in Alaska. As is shown in Table 1, tests

for antibodies to four serotypes of SMSV in arctic foxes were all negative. In contrast 6/85 (7%) of gray foxes on Santa Cruz Island had titers against SMSV-5 and 1 animal had SMSV-2 antibody.

The animals from the Prudhoe Bay area of Alaska were either from an inland population or ranged along the north shore and on ice floes where pin-niped contact is possible. Although foxes have been observed to travel 300 miles in a month (L. Eberhardt, pers. comm.), still an animal from the Prudhoe Bay vicinity would be removed from shore areas where the largest concentrations

TABLE 1. Serum neutralization Antibody titers against SMSV serotypes in three wild fox populations*.

Species	Dilution Serum	SMSV serotype			
		1	2	4	5
Gray fox <i>Urocyon littoralis</i> Santa Cruz Island, California	<10	85	84	85	79
	10	0	0	0	0
	20	0	0	0	1
	40	0	1	0	1
	80	0	0	0	2
	160	0	0	0	1
	320	0	0	0	1
	# positive	0	1	0	6
	total	85	85	85	85
Arctic fox <i>Alopex lagopus</i>	<10	19	19	19	19
	1:10>	0	0	0	0
	# positive	0	0	0	0
	total	19	19	19	19
Prudhoe Bay, Alaska					
Arctic fox <i>Alopex lagopus</i>	<10	16	16	16	16
	1:10>	0	0	0	0
	# positive	0	0	0	0
	total	16	16	16	16
St. Paul Pribilof Island, Alaska					

* Titers are expressed as reciprocal of serum dilution which neutralized 50% of wells containing 100 TCID₅₀ of virus.

of pinnipeds occur. Pribilof Island foxes on the other hand have ample access to pinniped carcasses and nesting birds. They feed on dead pups on the rookeries and can also pick up any remains that might be left on the fur seal harvest field. Our sample of 16 animals may have been inadequate for showing exposure to SMSV, especially if we consider our results on the California Channel Islands. There, we obtained at best 7% positive SN with SMSV-5; using this as a comparison we then expect only 1 positive animal in our Pribilof group.

The domestic dog occasionally is susceptible to experimental infection with VESV. Bankowski² has reported a suspicious but unconfirmed case of natural infection with VESV in a shepherd collie working on a pig farm where a severe

outbreak of VES was in progress. From results of serologic and susceptible host cell spectrum studies it is apparent that caliciviruses of marine origin have a potentially broad host range in both marine and terrestrial mammalian species including the canine. In addition to the sea lion, fur seal and elephant seal, the range of serologically positive species include the gray whale, Stellar sea lion and feral sheep and swine.

The results of the present survey show that certain fox populations may be exposed to and infected with caliciviruses in nature. The effect of such infection on the animals themselves or on their possible role in further terrestrial transmission is unknown at this time. Further testing of Alaskan foxes when samples are available is contemplated.

Acknowledgments

The authors wish to thank Dr. D. G. Constantine for the Channel Island fox sera, L. Eberhardt for the Prudhoe Bay, Alaska specimens, and H. L. Bray and D. E. Skilling for collection of the Pribilof Island samples and their able technical assistance.

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Received for publication 4 March 1977