Investigating Protozoal Parasites as Causes of Neurologic Disease in American Black Bears (*Ursus americanus*) that Contribute to Human-Wildlife Conflict (Abstract)

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ABSTRACT: American black bears (*Ursus americanus*) can be considered vertebrate pests when they come in conflict with humans and create potential public safety situations that require intervention by local wildlife or animal control departments. Black bears are both omnivorous and highly intelligent, and this combination of characteristics make these animals prone to human habituation and developing an association between humans and easy sources of food. Foraging behaviors can put black bears in undesired or unsafe contact with humans when bears root through garbage on private and public lands, consume crops, prey upon small livestock or pets, cause significant property damage, and wander onto roadways leading to traffic accidents. An increasingly recognized cause of bear-human conflict is neurologic disease, such as that caused by infectious pathogens or toxicity, leading to cognitive or behavioral changes. A unique neurologic disease affecting black bears was first observed in 2014 near Lake Tahoe on the border between California and Nevada. Since then, it has been reported in eight counties in California and two counties in Nevada. Affected bears exhibit a range of neurologic symptoms including tremors, seizures, head tilts, and loss of fear of humans (i.e., "dog-like" behavior). Affected animals are typically young (<3 years old), underweight, and most often present in the spring after early emergence from hibernation. Histopathologic examination of brain tissue from these bears revealed varying degrees of inflammation in the brain (encephalitis), but the cause of this encephalitis was not apparent. Testing for common infectious causes of encephalitis (e.g., rabies, canine distemper virus, canine adenovirus, West Nile virus) and common neurotoxins did not identify a cause of the inflammation. A novel gammaherpesvirus, circovirus, parvovirus, and anellovirus were isolated from subsets of affected bears; however, a direct correlation between viral infection and encephalitis has not been established to date.

The goal of this study is to investigate the potential role of protozoal parasites in this encephalitis of unknown origin, as members of this group of pathogens are known causes of encephalitis in humans and animals. Brain tissue from bears with encephalitis (n = 21) and unaffected bears (n = 15) from California and Nevada was screened via PCR targeting two loci commonly used to identify protozoal parasites (ITS1 and 18S). Protozoal parasite DNA was detected in 47.6% of bears with encephalitis (10/21) and 26.7% of unaffected bears (4/15). Parasites detected in bears with encephalitis included *Sarcocystis neurona* (4/21), *S. canis* (1/21), *S. felis* (1/21), an uncharacterized *Sarcocystis* sp. (1/21), *Toxoplasma gondii* (1/21), and an uncharacterized *Cystoisospora*-like species (2/21). *Sarcocystis neurona*, *S. canis*, and *T. gondii* are known to cause encephalitis in humans and animals. *Sarcocystis canis* is an increasingly recognized pathogen of bears and has been reported to cause inflammation in the brain, liver, and muscle in other geographical regions. The clinical significance of the poorly characterized protozoal species is uncertain. Parasites detected in unaffected bears included *T. gondii* (1/15), an uncharacterized *Sarcocystis* species (1/15) and an uncharacterized *Cystoisospora*-like species (2/15). These results suggest that protozoal parasites, particularly *Sarcocystis* species, may contribute to encephalitis in juvenile black bears, creating a public safety hazard at the human-wildlife interface.

KEY WORDS: American black bears, encephalitis, neurologic disease, parasites, protozoa, *Sarcocystis* spp., *Ursus americanus*

Proceedings, 30th Vertebrate Pest Conference (D. M. Woods, Ed.)
Paper No. 5. Published December 12, 2022. 1 p.