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Short Communication

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Is canine distemper virus (CDV) a lurking threat to large carnivores? A case study from Ranthambhore landscape in Rajasthan, India

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Abstract: Canine distemper virus (CDV) was reported in wild tigers from Russia and recently from India. Very few studies, however, have been carried out to gain an insight into the prevalence of the disease in India, particularly in the wild. CDV is the etiological agent of one of the most infectious diseases of domestic dogs. With the aim of exploring the threat CDV poses for tigers, a preliminary assessment was carried out to determine its prevalence from villages near Ranthambhore National Park in Rajasthan, India. Free-roaming dog populations within a 4-km-radius of the park's periphery were tested for antibodies against CDV. The seroprevalence of CDV antibodies in the sampled dogs was 86% (95% CI 78–91 %), indicating the probability of the dogs acting as a reservoir and having been exposed to CDV in the past. The seroprevalence of CAV antibodies was 44.23% (95% CI 35–54 %) and CPV antibodies was 95.19% (95% CI 91–99 %). This could threaten the tiger populations in the park, considering the close proximity of dogs to tigers. It is, therefore, crucial to assess disease threats at the domestic-wildlife interface and to establish management strategies for more effective conservation practices in the landscape.

Keywords: Disease dynamics, free-roaming dogs, Tiger, wildlife disease management.

The global Tiger *Panthera tigris* population faces threats due to various anthropogenic factors (Karanth & Chellam 2009; Walston et al. 2010; Jhala et al. 2015; Robinson et al. 2015). The populations also face new pressures associated with stochastic processes such as inbreeding depression and disease agents that have the potential to drive small, isolated populations to extinction (Timm et al. 2009; Kenney et al. 2014). In recent times, canine distemper virus (CDV) disease has emerged as one of the most highly contagious diseases with a fatality rate second only to rabies in canids (Nagao et al. 2012). The first major outbreak of CDV disease in large carnivores was reported in 1993 in the Serengeti, Tanzania, which reduced the lion population by 30% (Roelke-Parker et al. 1996; Nagao et al. 2012). In recent years, CDV has been recognized as a cause of death in Amur Tigers *Panthera tigris altaica* with the first diagnosed fatality from CDV in 2003 (Seimon et al. 2013). Following this, from 2004 to 2010, more CDV

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deaths in Amur Tigers were observed causing a significant decline in tiger numbers at Sikhote Alin (Gilbert et al. 2015). Recent reports have also confirmed cases of CDV in wild tigers in India (Guardian 2014). Studies in India looked at potential mitigation to prevent a spillover of diseases from dogs to wildlife (Belsare & Gompper 2013, 2015; Belsare et al. 2014). CDV spillover in endangered carnivore species is a serious conservation concern. Here we assess CDV antibody prevalence in free-roaming dog populations around a protected area in western India.

Methods

The study was conducted from July to August 2015 in the villages located in the peripheral area of the Ranthambhore National Park (RNP) located between 26.0173^{0}N and 76.5026^{0}E in Rajasthan, India. Villages located within a 4-km-radius of RNP were selected for sampling dogs. Free-roaming dogs found within these villages are most commonly known to wander into the park.

Dogs were caught with the help of villagers from the villages that fed and looked after them, and blood was collected via the cephalic vein using a hand-held syringe. Three to four dogs were sampled per village across 31 villages (Fig. 1). Blood samples were stored in EDTA vials at temperatures of 2–5 ^{0}C. A total of 121 samples was collected of which 17 samples were damaged during the collection and/or during transportation. Plasma was extracted from the remaining 104 samples and stored in a deep freezer maintained at -20^{0}C, at the School of Wildlife Forensic and Health, Nanaji Deshmukh Veterinary Science University, Jabalpur. The stored samples were analyzed for IgG antibodies against CDV using the DOT-enzyme linked immune sorbent assay (ELISA) test (Biogal's Immunocomb Canine Vaccicheck Antibody Test Kit; Biogal Galed Labs. Acs Ltd, Israel). A calibrated colour comb scale provided with the ELISA test kit was used to score the titer as high, moderate, or low. A high titer of IgG antibodies against CDV (>1:32 V.N. value) indicated a strong response to the antigen. The test kit is also designed to perform the titer test for two other pathogens—Canine Adenovirus (CAV) and Canine Parvovirus (CPV). Therefore, using the above-mentioned calibrated colour comb scale, a titer for antibodies against CAV and CPV was determined as well. A ≥1:16 V.N. value indicated a high antibody titer against CAV and similarly a ≥1.80 H.I. value indicated a high antibody titer against CPV.

Results

The seroprevalence of CDV antibodies in the sampled dogs was found to be 86% (95% CI 78–91 %). Only 14% of the samples showed negative results. None of the dogs tested had ever been vaccinated against CDV (pers. comm. district administration, 2015), suggesting that the dogs had prior natural exposure and recovery from CDV infection. The fact that a high percentage of dogs had been exposed to CDV could mean that they could potentially be a reservoir of the virus and that the dogs in these areas

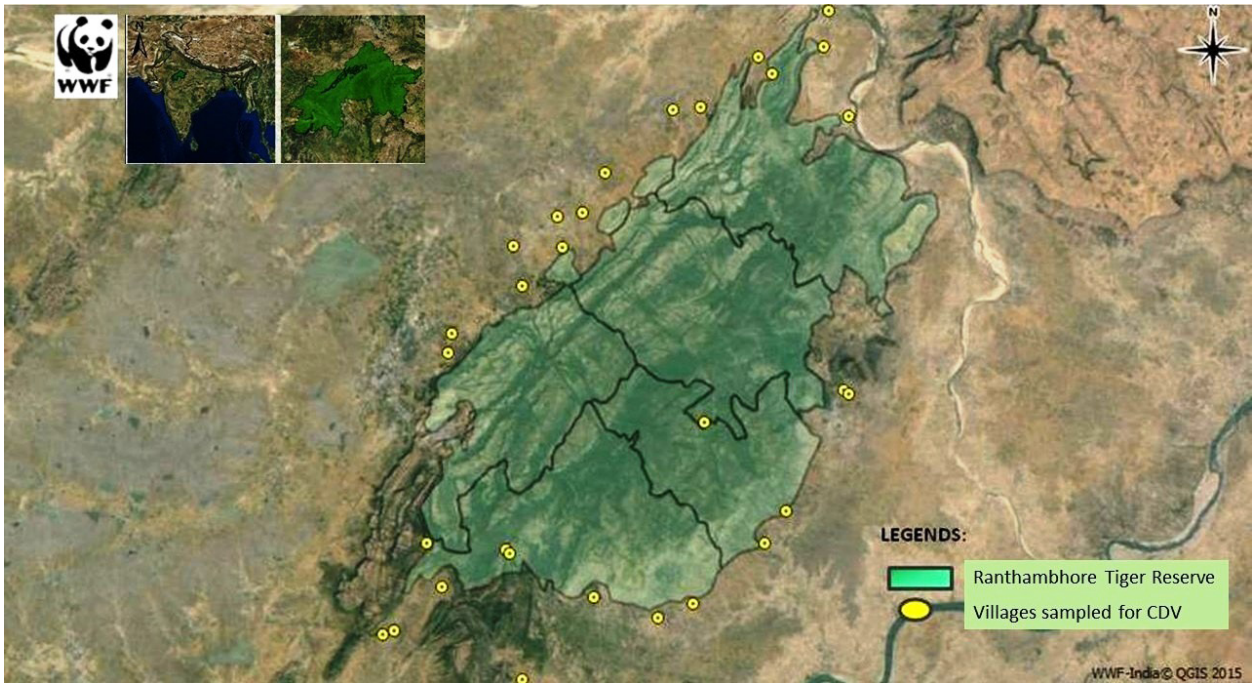

Figure 1. Villages sampled around Ranthambhore Tiger Reserve in Rajasthan, India.

were exposed to the virus through another infected animal or host. The seroprevalence of CAV antibodies in the sampled dogs was found to be 44.23% (95% CI 35–54 %). 46.15% of the samples tested negative for CAV. The seroprevalence of CPV antibodies in the sampled dogs was found to be 95.19% (95% CI 91–99 %). Only 2.88% of the samples tested negative for CPV.

Discussion

Our study reveals a moderate to high risk of exposure to CDV for the Tigers as well as the Leopards in RNP. With a population density of 6.4 Tigers per 100km^2 (Jhala et al. 2015), the transmission of the disease pathogen, in case of an outbreak, could be fairly rapid. A study of CDV infection in the local dog population surrounding the Serengeti in Tanzania has shown a spillover of CDV from the stray dog population to the lion population (Viana et al. 2015). Abundant free-roaming dog populations help expedite a higher contact rate between the stray dogs, livestock, and the wildlife population (Acosta-Jamett et al. 2015), which increases the risk of disease transmission and spread. The city of Sawai Madhopur, wherein RNP is situated, and the villages in the fringe of Ranthambhore is home to about 4,500 stray/feral dogs (Source: District Administration, Sawai Madhopur). Yoak et al. (2013) have also confirmed the presence of CDV in the stray dogs found in Sawai Madhopur. CDV antibodies have also been noted in exposed Wild Boar and deer species (Gilbert et al. 2015). CDV has been evaluated as a possible cause of disease and extinction risk in different species even outside of the order Carnivora and has also been demonstrated with serological evidence in a wide range of families and orders (Gutierrez & Saenz 2016). Further studies, however, will be required to determine and interpret this risk fully. Coexistence of susceptible and infected hosts could cause the back and forth transmission of the virus between multiple hosts, aiding the disease-causing pathogen to persist within a population or multiple species populations. This increases the threat for an endangered population of susceptible hosts such as the Tiger, particularly when the pathogen has the potential to increase the probability of extinction in the species (Gilbert et al. 2014).

It is, therefore, important to develop a disease surveillance strategy early on so as to deal with a probable CDV outbreak. Such a step requires an understanding of disease dynamics through further research. It would prove useful to obtain blood samples of live Tigers to test for the presence of CDV antibodies. For Tiger deaths reported within the park, it may be important to diagnose the presence or absence of CDV.

In an ideal situation, it would be preferable to maintain a smaller village dog population potentially for lower contact rates between dogs and wildlife and, therefore, fewer spillover events. Animal birth control (ABC) programs implemented in and around areas of conservation concern, in combination with restrictions to the movements of dogs in habitats occupied by species of conservation concern, might be useful in decreasing spillover events (Belsare & Gompper 2015).

Vaccination of local dog populations alone would probably be ineffective as a disease control strategy. Most adult dogs in such an environment are already immune to enzootic pathogens like CDV due to early natural exposure. As such, pup vaccination, rather than adult dog vaccination, should be evaluated as a potential disease control intervention (Belsare & Gompper 2015).

It is also suggested that disease control programs should have a strong component of public outreach (Belsare & Gompper 2015) and better awareness campaigns in such conservation concern areas. The National Tiger Conservation Authority, Government of India, has already issued a guideline for taking necessary preventive measures in and around protected areas (NTCA 2014). From a research perspective, a further epidemiological study should be undertaken to better understand the dynamics of CDV in natural ecosystems.

RNP, being home to 39 adult tigers, is an important source population for the species in the western part of India (Bhardwaj 2013; Jhala et al. 2015). Tigers from Ranthambhore have been translocated to places like Sariska and Mukundra, where the tiger population were locally extirpated. Therefore, it is imperative that such source populations are free from diseases like CDV, the outbreak of which in the region could cause a loss in the numbers of breeding females, affecting fecundity and thus causing an overall decline in species population. Therefore, such a source population needs to be managed with great efficiency in terms of disease management.

As human encroachment increasingly restricts the range of wild carnivores, the interaction between domestic animals and wildlife continues to rise. In such cases, urban-domestic species play a central role in the transmission of pathogens. RNP is situated in a high human population density area with over 300 villages located in a 5km-radius of the park (DeFries et al. 2010). There have been reports of Leopards killing stray dogs in the villages (Appel et al. 1994) which could possibly lead to the species contracting CDV from infected dog populations. Since Tigers and Leopards have prey resource overlap along with overlapping territories, CDV infection in Leopards increases the risk for disease contraction in the Tiger population.

Conclusion

The threat posed by multi-host diseases like CDV should be considered wherever Tigers coexist and interact with other carnivore species, as well in areas where villages are present adjacent to tiger reserves. While it is important to ensure that there is no spillover of CDV from the local dog population to Tigers and other wildlife, it is also imperative to maintain a stable population of such dogs through various means described earlier, so as to eliminate the risks of potential occurrence and transmission of diseases to the wild. The anthropogenic pressures in the form of poaching, retaliatory killings, and dog-transmitted diseases are a reflection of anthropogenic edge effects that occur in fragmented habitats (Gilbert et al. 2014). The most viable management strategy, therefore, would be to maintain Tigers in large and inter-connected populations that are able to withstand CDV and buffer the effects, should any outbreak occur. Our findings thus have important implications, highlighting a need to assess the reservoir dynamics of CDV to better assess the conservation threats to Tiger populations in the wild.

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